THE UNIVERSITY OF ALBERTA

MARKET PERFORMANCE OF THE ALBERTA PORK PRODUCERS' MARKETING BOARD

by

© STEVEN SAMUEL LEAVITT

A THESIS
SUBMITTED TO THE FACULTY OF GRADUATE STUDIES AND RESEARCH
IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE
OF MASTER OF SCIENCE

IN

AGRICULTURAL ECONOMICS
DEPARTMENT OF RURAL ECONOMY

EDMONTON, ALBERTA
FALL, 1981

THE UNIVERSITY OF ALBERTA

RELEASE FORM

NAME OF AUTHOR . . . STEVEN SAMUEL LEAVITT

TITLE OF THESIS . . . MARKET PERFORMANCE OF THE ALBERTA PORK PRODUCERS' MARKETING BOARD

DEGREE FOR WHICH THESIS WAS PRESENTED . . MASTER OF SCIENCE

YEAR THIS DEGREE GRANTED . . 1981

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The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research, for acceptance, a thesis entitled MARKET PERFORMANCE OF THE ALBERTA PORK PRODUCERS' MARKETING BOARD submitted by STEVEN SAMUEL LEAVITT in partial fulfilment of the requirements for the degree of Master of SCIENCE

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ABSTRACT

This study evaluated the market performance of the Alberta Pork Producers' Marketing Board which became the single selling agency for hogs in Alberta in 1969. Concepts of pricing and operational efficiency were applied in the evaluation and analysis, with comparisons made of alternative market areas (Winnipeg, Toronto and the average of the U.S. 7 markets) during various time periods.

Market information was assessed because improvements tend to increase operational and pricing efficiency. The timeliness, quantity, and quality of hog market information have increased since the Board's inception.

Cost reductions in the hog marketing system were used to assess operational efficiency since the Board's inception. Cost savings were introduced through the Board's establishment of the Producers' Hog Indemnity Fund and assembly yard system. The Board's sales department and data processing department have also shown other areas of increased operational efficiency through their hog allocation system, "check float mechanism", and hog settlement procedure.

Pricing efficiency was evaluated through graphical illustrations, statistical measurements, correlation coefficients and econometric models. Results from these techniques were compared between different market areas during various time periods, which represent policy changes of the Board. Results of the models which tested the relationship between price spreads between various markets and transportation costs, and analysis of the relationship between alternative price variables indicated improvements in pricing efficiency had occurred since the Board was established. However, evidence from the model which tested the relationship between price variables and supply variables between various markets and time periods suggested that after the Board's formation improvements in pricing efficiency were lacking.

The major conclusions from this study were that the Board's selling procedures improved market information and operational efficiency. However, a firm conclusion concerning pricing efficiency could not be made because of the mixed evidence on improved pricing efficiency since the Board's inception. It was recommended that other agricultural marketing sectors become involved in co-operative selling through a single selling agency.

ACKNOWLEDGEMENTS

The author is grateful to the many institutions and individuals who have contributed their support and knowledge to make this study possible. Support and interest was given by the Alberta Pork Producers' Marketing Board and its staff. L. Unterschultz, G. Whalley, R. Buray and other staff members were there to provide guidance and direction in the organization of this study. Financial assistance was also provided by the Alberta Agricultural Research Trust which was very much appreciated.

My sincere thanks go to Dr. M.H. Hawkins and Dr. M.M. Veeman for their continual encouragement, direction and understanding. Their cooperative efforts provided a good learning atmosphere which created a rewarding experience for me.

Special thanks go to the other members of my supervisory committee. Dr. F. X. Aherne and L. Untershultz gave many constructive critisms and helpful comments.

Gratitude is extended to other staff and fellow graduate students of the Department of Rural Economy for their assistance and encouragement, especially C.A. Shier, E. Shapka, J. Copeland and Dr. W.E. Phillips.

I am also grateful to those who provided editorial comments and advice. M. Dineen and B. Bucknell made many helpful suggestions towards the completion of this paper.

I am also grateful to my parents who enabled me to pursue my educational career.

My most sincere thanks go to my loving wife and daughter who endured my absences from home with cheerfulness. My wife Pat encouraged and motivated me while sharing my discouragements and aspirations at all times. She also competently typed all the drafts and made editorial comments. Our daughter, Stacy, always brightened up my day after I returned home from studying. To both of you, thank you.

This work is dedicated, with love, to my wife Pat who made this study a reality.

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CHAPTER I

OVERVIEW

INTRODUCTION

This study deals with the marketing of hogs in Alberta during the past twenty years. During this time period many institutional changes which have influenced this marketing system will be evaluated. In this chapter, the nature of the problem is outlined, the objectives of the study are summarized together with the scope, methodology and format.

PROBLEM

In the early 1960's, Alberta hog producers became concerned about the procedure for pricing market hogs. By the late 1960s , 97 percent of Alberta's slaughter hogs were sold through limited negotiation or on a noncompetitive basis.[1] With the approval of the producers the Alberta Pork Producers' Marketing Board (APPMB) was established in October, 1969. The mandate given the Board was in essence to increase the bargaining power of hog producers and provide for more competition among the pork packing plants in Alberta, thereby improving market performance.

---

[1] M.H. Hawkins, et al., Development and Operation of the Alberta Hog Producer's Marketing Board, Rural Sociology Bulletin 12 (Edmonton: University of Alberta, March 1977), p. 1.

The specific problem of this study is to determine the market performance of the APPMB since its inception.

OBJECTIVES

The objective of this study is to determine if the APPMB has fulfilled the mandate given it.

More specifically:

1) To evaluate the operational and pricing efficiency of the APPMB over time, and
2) to examine the influences of policy and operational changes of the APPMB upon market performance.

SCOPE AND METHODOLOGY

This study is based upon analysis of weekly, secondary data collected for dressed weight hogs, and analysis of price, quantity and trade relations in pursuit of the objectives stated earlier. Differences between weekly prices in various market regions during different time periods will be examined.

It is hypothesized that pricing efficiency in the industry increased after the inception of the APPMB. Several techniques will be employed to test this hypothesis.

1) Analysis of price differentials will be performed graphically and statistically on average weekly price spreads between Edmonton-Winnipeg, Edmonton-Toronto, Edmonton-U.S., Winnipeg-Toronto, Winnipeg-

U.S., Toronto-U.S. for dressed weight hogs, both prior to and following the formation of the APPMB. Price spreads between these markets will be evaluated during different time periods, after the Board's inception, representing major policy changes. The average price for the major U.S. markets will be used as a norm for comparing differences. The variability in prices will be measured by the mean, standard deviation, and coefficient of variation for the different market areas. This was a technique utilized by Veeman[1] who evaluated the poultry industry in Canada. This present study will use data from 1961 to 1980 to assure proper investigation before and after the inception of the APPMB.

2) A further test for pricing efficiency will be made using regression analysis and correlation coefficients. Results of these analyses will be compared over time periods to determine if the Board's actions have had any influence to improve price and quantity relationships between markets.

---

[1] M.M. Veeman and T.S. Veeman, "Marketing Boards in Western Canada," A Report to the Canada West Foundation Task Force on Western Canadian Agriculture, Edmonton, University of Alberta, 1980, pp. 36-53. (Mimeographed.)

3) Improvements in market information are aimed most directly at improvements in pricing efficiency.[1] The research will attempt to determine if the quality, quantity, accuracy and timeliness of market information has been improved since the Board's beginnings. A measurement of the above criteria will be a qualitative and subjective assessment to determine if buyers and sellers are adequately and equally informed to allow prompt, intelligent responses to changing market conditions.[2]

It is further hypothesized that operational efficiency in hog marketing increased after the formation of the Board. Operational efficiency will be measured by examining changes in marketing costs (from the producer to the packinghouse) since the Board's formation. Many services and cost reductions which the Board offered will be examined. Examples are improved market information, use of assembly yards, uniform daily flow of hogs, insurance indemnity fund, check float, availability of alternative markets, and carcass identification.

The evolution of the objectives, goals, and policy changes of the Board since it began will be traced. Some of these market organization variables will be related to the data series by means of graphic illustration and statistical analysis. Their relative relationships to market performance will be assessed.

---

[1] W.F. Williams and T.T. Stout, Economics of the Livestock-Meat Industry (New York: The Macmillan Company, 1964), p. 546.

[2] Ibid., p. 445, See also J.S. Bain, Industrial Organization (New York: John Wiley and Sons, Inc., 1959), p. 334.

ORGANIZATION OF THE STUDY

Subsequent chapters will be organized in the following way: Chapter II will describe the development of the hog and pork industry in Alberta and Canada. Chapter III describes the conduct of the packing plant industry in Alberta, while Chapter IV provides a selected review of theoretical concepts and empirical studies related to market performance. In Chapter V, the methodology used in this study is presented, while Chapter VI provides an assessment of market information, promotion, operational efficiency, and pricing efficiency. Chapter VII presents the results of the empirical analysis, and Chapter VIII will give a summary of the results, conclusions, and recommendations of this study.

CHAPTER II

THE DEVELOPMENT OF THE HOG AND PORK INDUSTRY IN CANADA AND ALBERTA

INTRODUCTION

This chapter will provide a historical background, and indicate major developments of the hog and pork industry in Canada and Alberta which have occurred during the past two or three decades. Important events which have transpired and the development of the Alberta Pork Producers' Marketing Board (APPMB) will also be presented.

DEVELOPMENT OF THE HOG AND PORK INDUSTRY IN CANADA

ECONOMIC CONTRIBUTION AND TRADE PATTERNS

> The Canadian pork industry is an important sector of the agricultural economy... it accounts for 9 to 12 percent of total farm cash receipts... The industry relies on a land base which produces 100-120 million bushels of feedgrain and 20 million bushels of protein supplement annually, since 80 percent of the hog ration is grain... The industry provides a variety of employment: in the primary sector - hog production; in the secondary sector - slaughtering, processing and merchandising. Additionally, it contributes significantly to support industries, such as feed manufacturing and transportation... with an estimate that in 1976, the pork system contributed at least $1.6 billion to the economy.[1]

---

[1] Agriculture Canada, "The Canadian Pork Industry" (Ottawa: August 1977), p. 1.

During the past decade, the major development in Canada's pork trade with other countries was the change from the large deficit which existed from 1975 to 1977, to a strong surplus position in 1979 and 1980 (Table 2-1). "The main reasons for the switch were the continued increases in the national hog production and the continued low value of the Canadian dollar relative to the U.S. dollar since 1977."[1] The three to four year hog cycle also had some impact on increased production in 1979 and 1980. In 1980, Canada's total exports of hogs and pork accounted for an average of more than 20 percent of the national output of hogs. This type of situation had not occurred since World War II.[2] The U.S. market has considerable influence on the Canadian hog industry because of the comparative ease with which pork can be traded. The U.S. price also tends to provide a floor or ceiling to the Canadian market because of the economic pressure of the much larger American markets.[3]

---

[1] Agriculture Canada, Marketing and Economics Branch, "Animals and Animal Products", Market Commentary (Ottawa: December 1980), p. 18.

[2] Ibid., p. 19.

[3] Agriculture Canada, Policy, Planning and Economics Branch, Commodity Forcasting Models for Canadian Agriculture, Vol. 1 (Ottawa, October 1978), p. 62.

TABLE 2-1

Canada: Annual Pork Exports and Imports (Product Weight)

Year	Exports			Imports		Net Balance	
	U.S.A.	Japan	All Outlets	U.S.A.	All Sources	Canada-U.S.A.	All Countries
	Million pounds						
1970	58.7	6.4	69.0	22.9	30.8	+35.8	+38.2
1971	66.4	20.1	95.2	13.4	23.7	+53.0	+71.5
1972	59.6	45.4	111.2	33.9	41.7	+25.7	+69.5
1973	65.2	45.2	120.4	42.2	50.6	+23.0	+69.8
1974	45.1	28.9	87.2	62.6	67.7	-17.5	+19.5
1975	27.4	53.8	85.2	92.8	96.5	-65.4	-11.3
1976	19.2	59.3	81.8	191.0	194.6	-171.8	-112.8
1977	19.8	74.0	96.3	197.0	199.7	-177.2	-103.4
1978	44.4	70.0	118.8	112.8	116.7	-68.4	+2.1
1979	85.8	70.2	169.7	67.7	71.3	+13.1	+98.4
1980[1]	115.8	46.5	176.0	20.3	21.0	+95.5	+155.0

[1] January to the end of August

Source: Agriculture Canada, Marketing and Economics Branch, "Animals and Animal Products," Market Commentary (Ottawa: December, 1979 and 1980).

CONSUMPTION

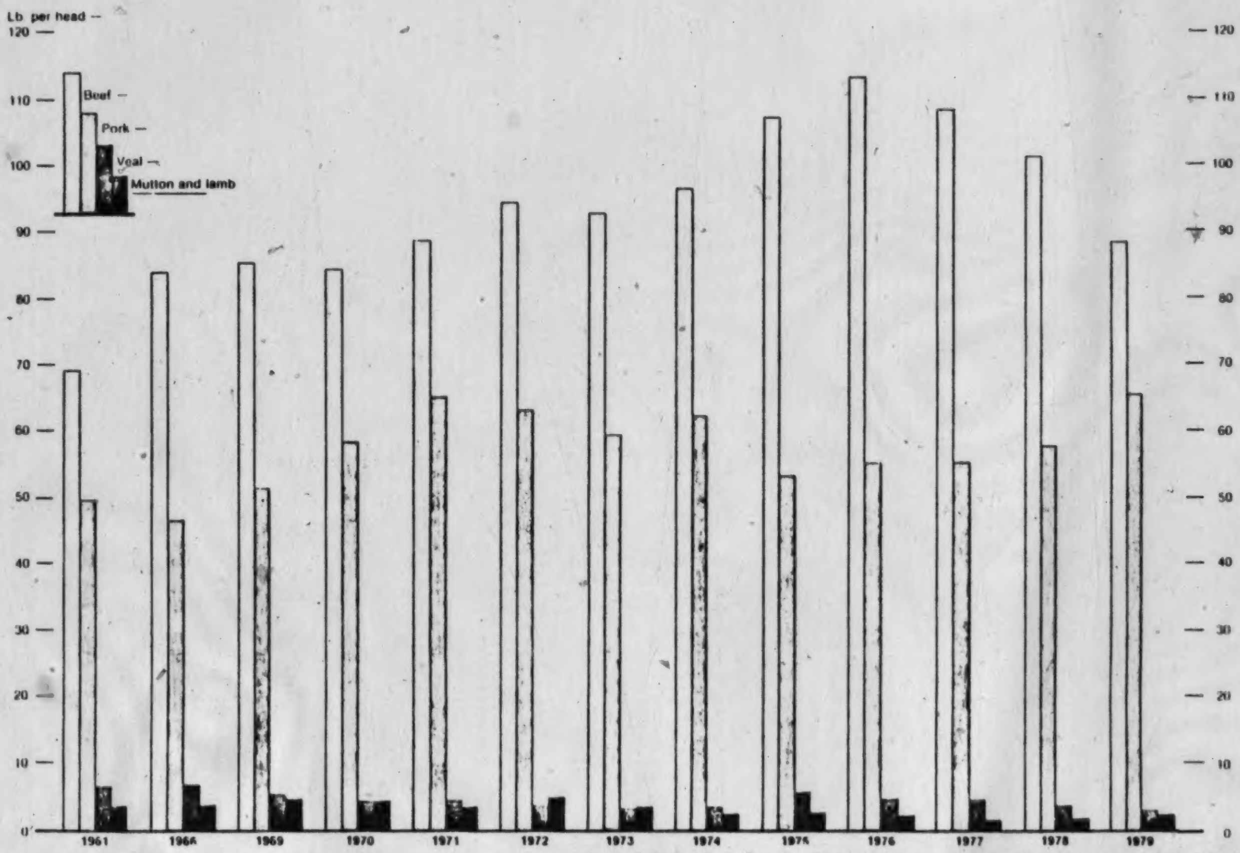
Per capita consumption of pork shows yearly fluctuations (Figure 2-1). The amount of pork consumed per person has ranged from close to 45 pounds in 1966, to over 60 pounds in 1971 and 1979. In comparison, since 1961 per capita consumption of beef steadily rose from below 70 pounds in 1969 to over 110 pounds in 1976 and has steadily decreased since 1976 (Figure 2-1). In 1976, Hassen and Johnson estimated the elasticities of demand for beef and pork. Their results indicated a direct price elasticity of -.8522 for beef and -.9547 for pork. A 10 percent increase (decrease) in the price of beef (all else being equal) indicates a decrease (increase) of 8.5 percent in beef consumption and the same percentage price change in pork infers a decrease (increase) of 9.5 percent in pork consumption. Hassen and Johnson also estimated the income elasticity of demand as .5057 for beef and .1325 for pork. A 10 percent increase (decrease) in income implies an increase (decrease) of 5.1 percent in beef consumption and 1.3 percent in pork consumption.[1] Estimated cross price elasticities for meats were positive, "implying that consumers view their meats as substitutes rather than complements... The results also suggest that changes in beef prices have a much greater effect on pork consumption than vice-

---

[1] Zuhair A. Hassen and S.R. Johnson, Consumer Demand for Major Foods in Canada (Ottawa: Agriculture Canada, April 1976), p. 41.

FIGURE 2-1

Per Capita Disappearance of Meat, Canada (Cold Dressed Carcass Basis)



Source: Statistics Canada, Livestock and Animal Product Statistics, Catalogue No. 23-203, 1979.

versa."[1] Together with the observed price and quantity changes in the Canadian market over the past two decades, these factors appear to explain some of the patterns which have occurred in beef and pork consumption.

PRODUCTION

Hog cycles tend to occur in the short run due to seasonal factors and also over three to four year periods reflecting the long run hog cycle. These cylces reflect the flexibility of production in the swine industry. The relatively low capital investment required for a small hog operation and the short gestation period of brood sows enable some farmers to move in or out of production fairly easily.[2] Although, capital requirements have become much greater in the past few years which would tend to reduce the movements into and out of hog production. The seasonality of farrowing and the time lags between producer responses to price along with faulty forecasting of prices by individual producers create the cycles (Figure 2-2). With the large degree of variability in production and the less variation in pork consumption, it becomes necessary to import and export hogs and pork and to build up stocks of pork. Pork is usually stored by freezing and canning. Six months is the usual limit for storing frozen pork while canned pork will usually keep

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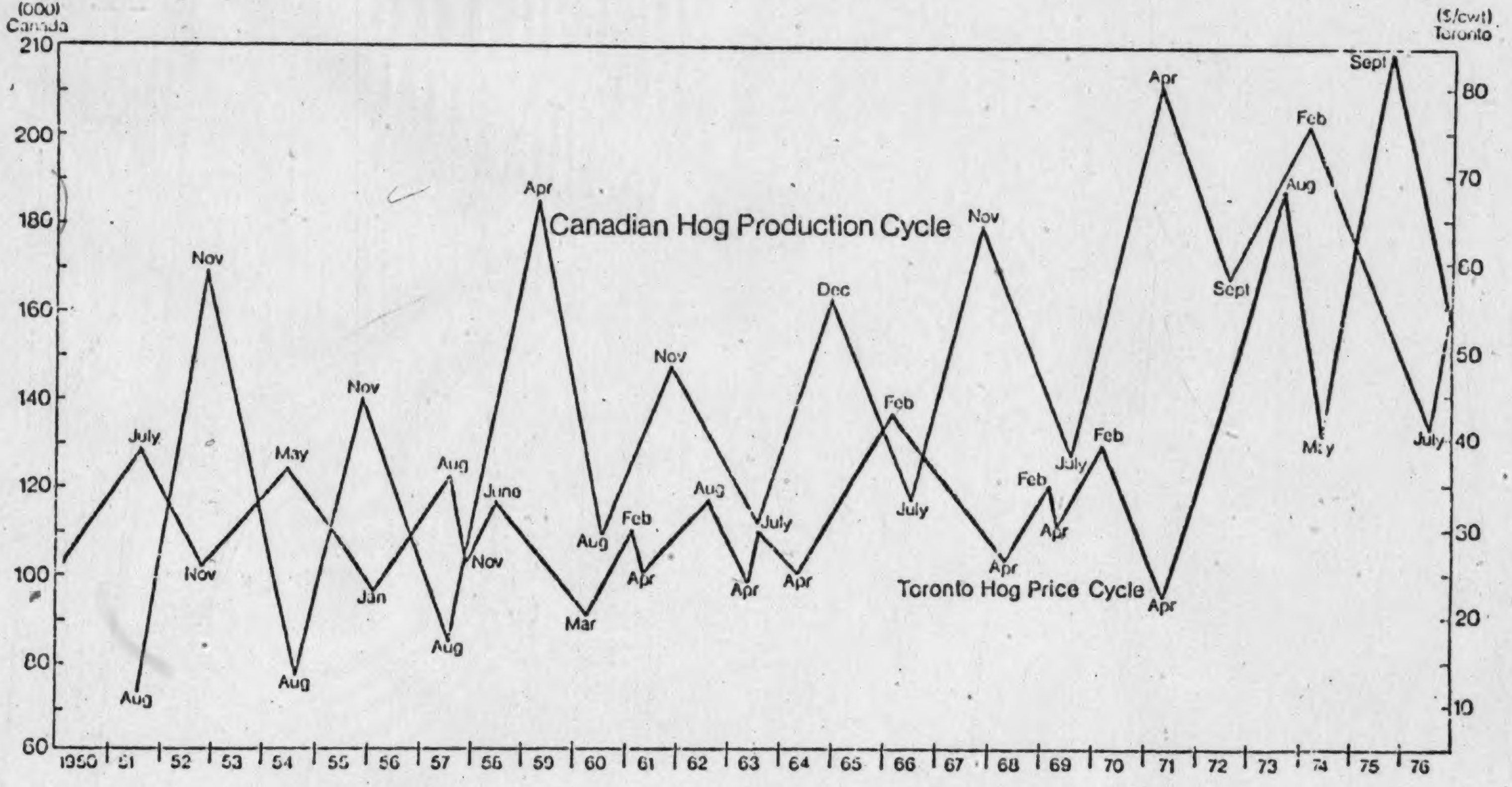
[1] Ibid., p. 29.

[2] James L. Dawson, A.A. Warrack and M.H. Hawkins, Locational Analysis for Alberta Hog Assembly Centers, Agricultural Economics and Rural Sociology Bulletin 11 (Edmonton: University of Alberta, March 1971), p. 3.

FIGURE 2-2

Hog Price and Production Relationship Between the Toronto Price and Average Weekly Slaughter Numbers in Canada



Source: Foodwest Resource Consultants, Pork Industry in the Alberta Economy, prepared for: Alberta Pork Producers' Marketing Board (Edmonton, Alberta: March 1980) p. 142.

indefinitely.[1] These stocks assist in creating greater stability between the variations of supply and demand.

WESTERN AND EASTERN CANADIAN PATTERNS OF GROWTH IN HOG PRODUCTION

Ontario, Quebec and Alberta produce the largest number of hogs in Canada. Ontario and Quebec each produce approximately 33 percent of Canadian hogs while Alberta produces about 12 percent (Figure 2-3). Since 1975, Ontario and especially Quebec have experienced major increases in hog production and gradings, while the prairie provinces have encountered decreases (Figures 2-3 and 2-4). Western Canadian hog producers' share of national slaughter dropped to 29 percent in 1979 from a high of 46 percent in 1971. Growth and development of the hog industry in eastern Canada is mainly attributed to improved hog enterprise returns, the relative lack of opportunities in dairy and poultry production, and a lack of off-farm employment. Western Canadian producers were faced with a strong cash grain market from 1973 to 1975 which provided a profitable alternative to hog production.[2] There have also been non-agricultural alternatives for labor and capital during western Canada's rapid industrial development in the 1960s and 1970s.

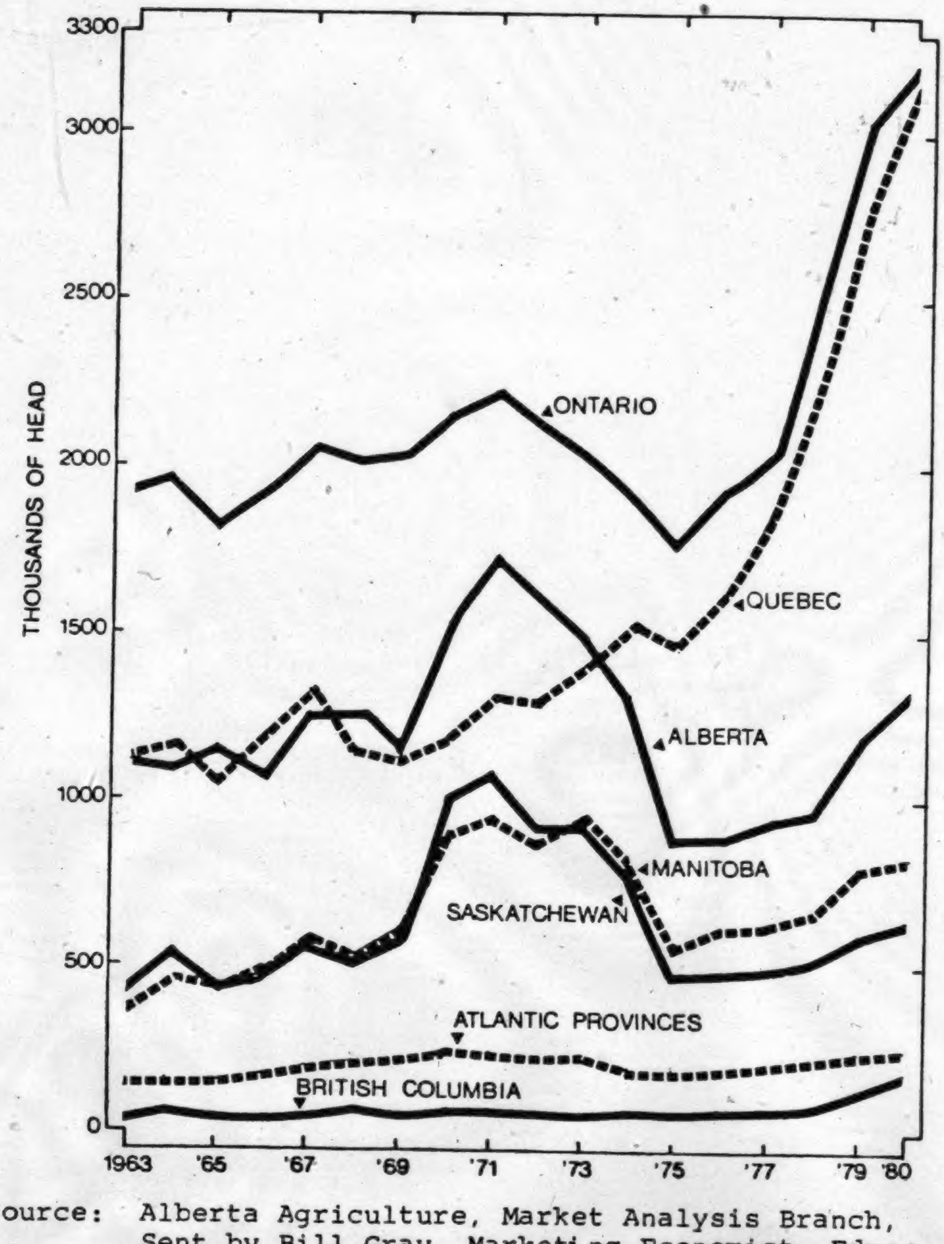
---

[1] James W. Lockhart, "Alberta Hog Market, Conduct and Performance" (M.S. Thesis, Department of Agricultural Economics, University of Alberta, Edmonton, 1967), p.47.

[2] Agriculture Canada, Policy, Planning and Economics Branch, "Animals and Animal Products," Market Commentary (Ottawa: December 1979), p. 23.

FIGURE 2-3

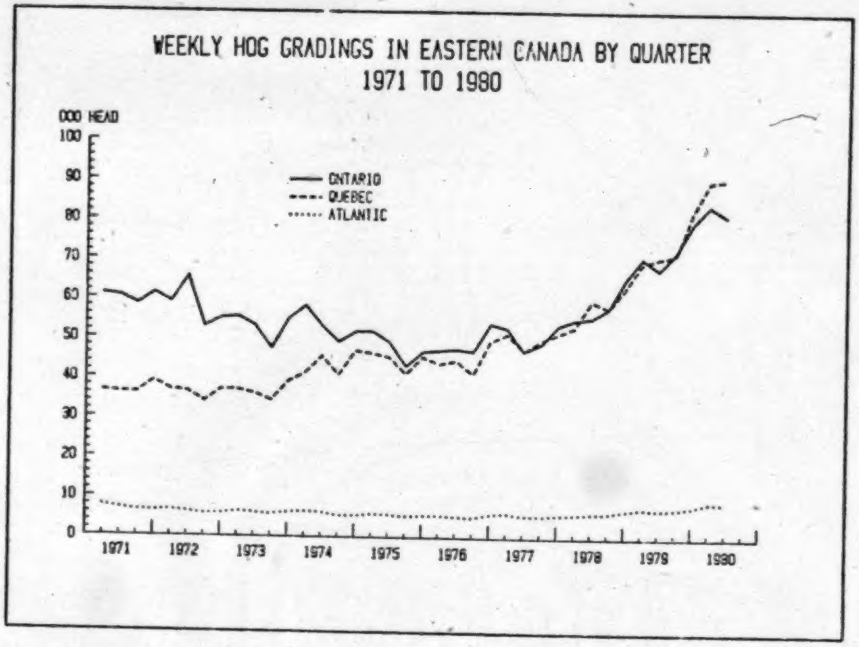
Hog Inventories, July 1

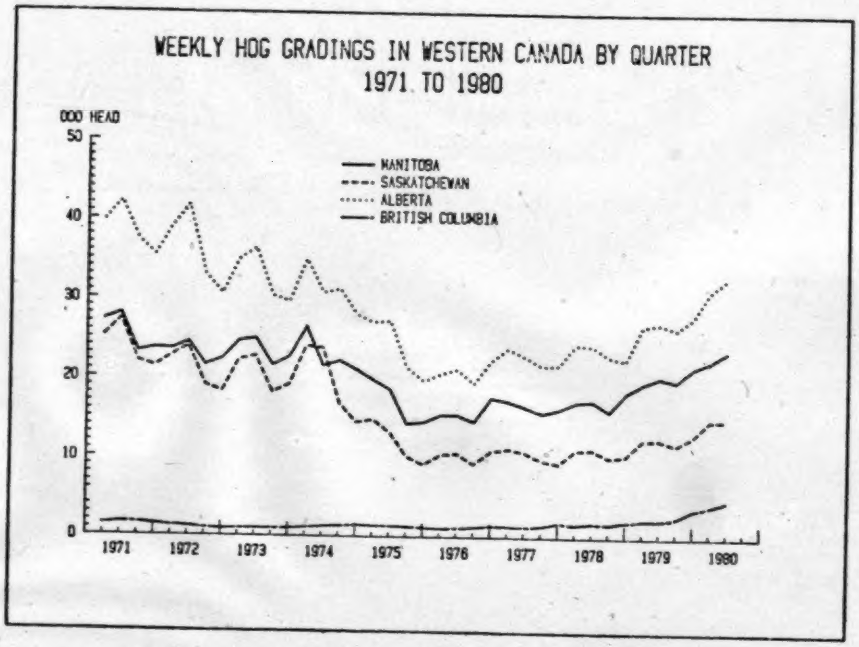


Source: Alberta Agriculture, Market Analysis Branch, Sent by Bill Gray, Marketing Economist, Edmonton, 1980.

FIGURE 2-4

Weekly Hog Gradings in Eastern and Western Canada





Source: Agriculture Canada, Marketing and Economics Branch, "Animals and Animal Products," Market Commentary (Ottawa: December, 1980), p. 273.

"In addition, the existence of government price support programs ... and quotas for some of these alternative enterprises (e.g., poultry, eggs and dairy) have affected the response that hog producers made to changing prices and costs."[1]

DEVELOPMENT OF THE HOG AND PORK INDUSTRY IN ALBERTA

PRODUCTION

Alberta's annual production has varied from approximately 25 percent of the Canadian total in 1961 to 12.5 percent in 1979. Hog sales accounted for $172 million or 10.8 percent of total farm cash receipts received by Alberta producers from the sale of livestock and livestock products during 1979.[2] Approximately 80 percent of the hogs produced in Alberta are located in the central region of the province (Figure 2-5). "Hog production is concentrated in this area because of the cultural background of the residents, the abundance of feed grains, and the proximity to highways and markets."[3]

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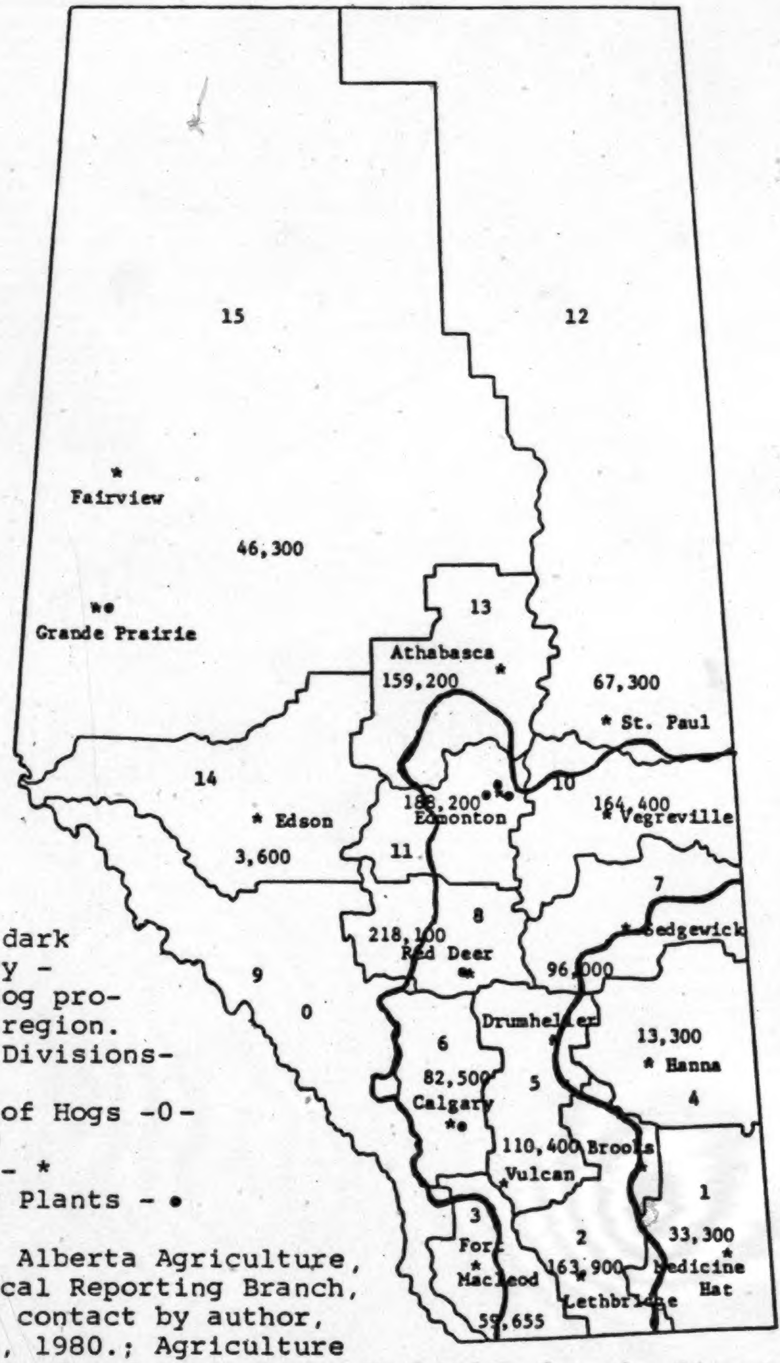
[1] Agriculture Canada, Policy, Planning and Economics Branch, Commodity Forcasting Models for Canadian Agriculture, Vol. 3 (Ottawa: October 1978), pp. 61-62.

[2] Alberta Treasury, Bureau of Statistics, Alberta Statistical Review (Edmonton: May 1980), pp. 66 and 69.

[3] James L. Dawson, et al., op. cit., p. 4.

FIGURE 2-5

Location of Hogs in Alberta



Legend:
Inside dark boundary - Major hog producing region.
Census Divisions- 1-15
Number of Hogs -0- 218,000
Cities - *
Packing Plants - ●

Source: Alberta Agriculture, Statistical Reporting Branch, personal contact by author, Edmonton, 1980.; Agriculture Canada, Food and Agriculture Marketing Branch, _Livestock Market Review_ (Ottawa: 1979).

PRODUCTION MINUS CONSUMPTION BALANCE

Alberta's quantity of surplus pork has declined since 1975. Provincial requirements absorbed approximately one third of Alberta's total production of pork and pork products in the early 1960s. In the late 1970s Alberta absorbed approximately three quarters of its total production. This change is attributed to the increase in population and consumption in Alberta as well as to some decrease in production (Table 2-2). British Columbia, a major deficit area for pork, (Table 2-2) imported the major share of its requirements from northwestern United States and Alberta. The remainder of Alberta's production has been exported to Japan and the northwestern United States. In the past couple of years, Alberta has imported hogs from Saskatchewan which has been a pork surplus area (Table 2-2) and from the northwestern United States in order to maintain its export markets.

The interprovincial pork trade between the three most western provinces of Canada has a major affect on the Alberta market. From 1976 to 1979 domestic pork production minus domestic consumption for the three most western Canadian provinces has indicated a trade deficit (Table 2-2).

TABLE 2-2

Imputed Trade Balance For Pork in the Three Western Canadian Provinces (Domestic Production Minus Domestic Consumption (000's lbs.))

YEAR	B.C.	Alberta	Total for BC & Alta.	Sask.	Total for All Three Western Provinces
1961	- 39,313[1]	130,656	91,343	43,295	134,638
1962	- 47,449	140,681	93,182	34,232	127,464
1963	- 56,850	107,988	51,138	16,464	67,602
1964	- 63,041	133,383	70,342	31,538	101,880
1965	- 54,694	139,968	85,274	29,355	114,629
1966	- 59,102	117,261	58,159	34,273	92,432
1967	- 69,967	129,095	59,128	41,883	101,011
1968	- 73,645	148,659	75,014	35,028	110,042
1969	- 71,880	112,622	40,742	41,332	82,074
1970	- 90,025	147,567	57,542	76,799	134,341
1971	-102,855	205,879	103,024	103,187	206,211
1972	-114,487	173,884	59,397	100,141	159,538
1973	-113,993	168,019	54,026	100,177	154,203
1974	-125,646	135,769	10,123	93,503	103,626
1975	-109,913	85,991	-23,922	48,510	24,588
1976	-119,992	63,214	-56,778	39,584	-17,194
1977	-118,895	67,244	-51,651	36,061	-15,590
1978	-120,425	65,964	-54,461	45,982	- 8,479
1979	-137,148	82,015	-55,133	38,229	-16,904
1980[2]	-119,000	112,000	- 7,000	58,000	51,000

[1] - sign denotes a negative trade balance while no sign denotes a positive trade balance.

[2] 1980 production of pork are actual figures while domestic disappearance are 1979 figures, since the 1980 per capita pork consumption was not published at the time this study was completed.

Source: Author's work (based on the following data: Statistics Canada, Livestock and Animal Products Statistics, Catalogue No. 23-203, 1967, 1975, 1979.; Statistics Canada, Estimates of Population for Canada and the Provinces, Catalogue No. 21-201, 1979.; Canadian Pork Study, Spatial Price Differences for Hogs in Canada (Ottawa, Ontario: 1979), pp. 6.28-6.47.; Agriculture Canada, Food and Agriculture Marketing Branch, Livestock Market Review (Ottawa: 1961-1979).

Provincial consumption of pork was calculated by multiplying per capita consumption data for Canada by the provincial population levels. Factors such as differences in average personal disposable income, tastes, etc., which would result in actual consumption differences were ignored.

Production was calculated by multiplying the average cold trimmed weight of hogs in Canada by the number of hogs slaughtered through federally and provincially inspected and uninspected plants in each province.

The difference between production and consumption gave the surplus or deficit position of each province.

Over time, agriculture has become a highly specialized industry. Hog production has also become more specialized with a tendency toward larger production units. As a reflection of this trend in Alberta, 41,017 farmers reported hog inventories in 1961, 28,544 farmers in 1966 and in 1971 26,204 farmers.[1] In 1978 approximately 9,000 farmers reported hog inventories in Alberta.[2] The trend is also illustrated by the fact that in 1961, 12 percent of hog production units reported hog inventories over 77 hogs, and by 1971 the number of producers reporting hog inventories of this size had increased to approximately 25 percent (Figure 2-6). However, in 1978 the majority of hog producers still had relatively small production units with 87 percent of the production units reporting hog numbers below 200 head. This large proportion of producers accounted for only 25 percent of the hogs in Alberta. In contrast, a mere 2.4 percent of producers reporting hog inventories over 1000 head produced 37 percent of the hogs in Alberta in 1978. These tendencies are illustrated in Figure 2-7, which also shows that Saskatchewan and Manitoba had comparable size distributions of producers.

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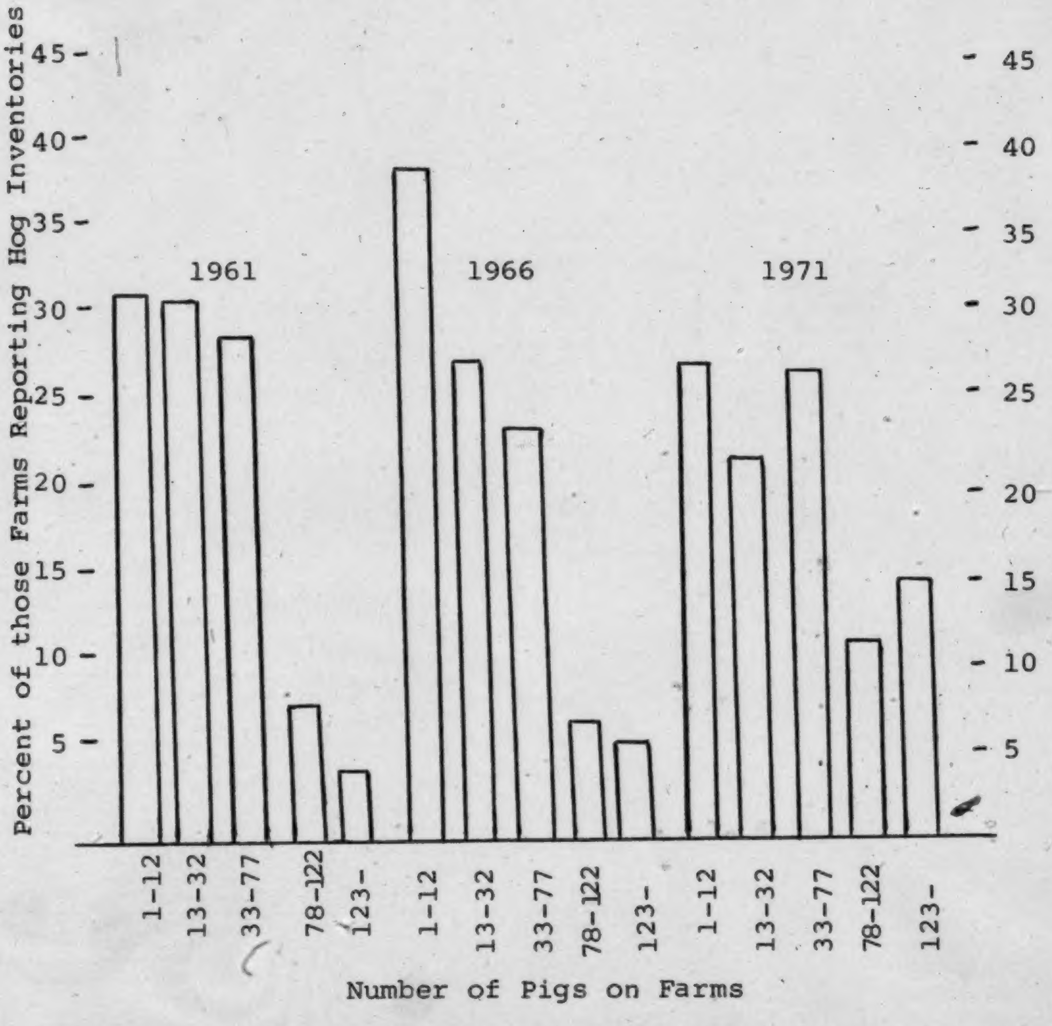
[1] Statistics Canada, Census of Canada, Agriculture Alberta, Catalogue No. 96-710, Vol. IV - Part 3, 1971, p. 8-1.

[2] Greg Whalley, "The Western Canadian Hog Industry in the Eighties," paper prepared for the Canada West Foundation Task Force on Western Canadian Agriculture, Edmonton, 10 January 1980, p. 9. (Mimeographed.)

FIGURE 2-6

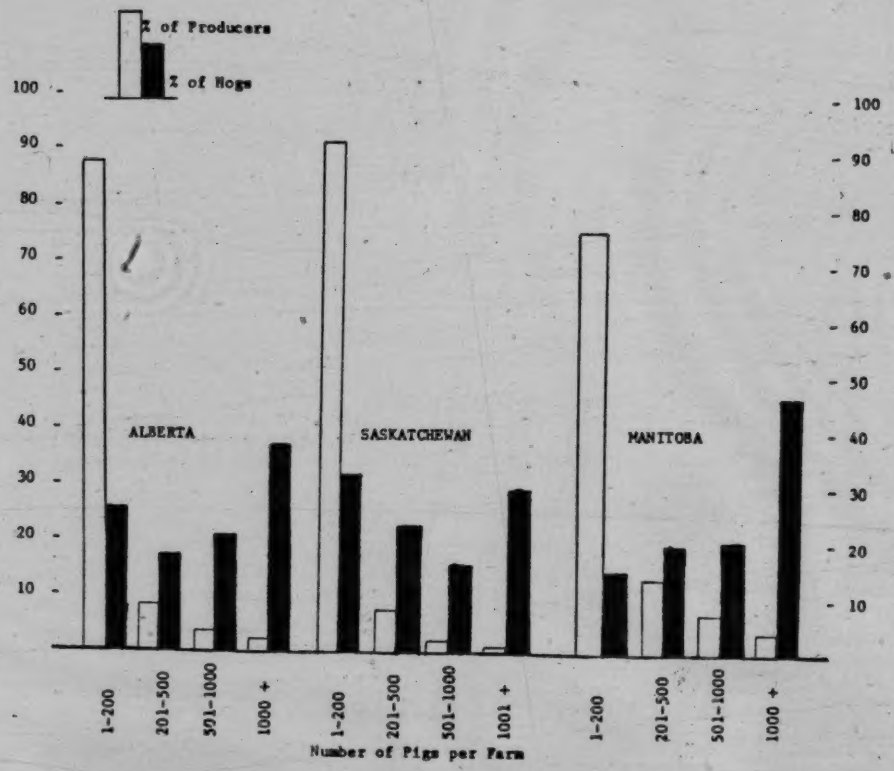
Number of Pigs on Farms
1961 - 1971



Source: Based on Data from Statistics Canada, Census of Canada, Agriculture Alberta, Catalogue No. 96-710, Vol. IV - Part 3, 1971, p. 10-1.

FIGURE 2-7

Hog Production Size In Relation to The Percent of Producers and Hogs For 1978



Source: Based on data from Greg Whalley, "The Western Canadian Hog Industry in the Eighties," paper prepared for the Canada West Foundation, Edmonton, January 10, 1980, p. 9. (Mimeographed.)

ALBERTA PORK PRODUCERS' MARKETING BOARD

During the 1960s, hog producers in Alberta became concerned about the structure of the hog industry. Manning indicated in 1965 that "less than 5 percent of the total number of hogs marketed were sold at public auction in Calgary and Edmonton, and this small number established the base prices for most of the other hogs sold."[1] There may have been advantages in this system for the larger producers as the "packers introduced various means of awarding producers, such as premium payments, quick payment, quick kill, assembly and transportation cost subsidies, and other prearranged formulas."[2]

If a perfectly competitive market exists, neither the buyers nor the sellers can exert more market power on the other. However, market power is strengthened for either the buyers or sellers as one side becomes highly concentrated. Reschenthaler implies that a number of costs affecting market power show up under the heading of poor performance. Examples are inefficiencies in allocation, technology and dynamics. Additionally, as competitive forces are reduced, "firms in an oligopoly might not try as hard to keep their costs down or artificially depress prices of resource inputs."[1]

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[1] Travis W. Manning, Performance of the Hog Marketing System in Alberta, Agricultural Economics Research Bulletin No.4 (Edmonton: University of Alberta, July 1967), p. 9.

[2] Richard S. Andersen, "An Economic Analysis of Daily Hog Price Fluctuations and Supply Response," (Unpublished M.S. Thesis, University of Alberta, Edmonton, 1971), p. 14.

The hog producers in Alberta acted collectively when they became aware of market power existing among the packing plants. This is the reaction Galbraith implies by stating "...power on one side of the market creates both the need for, and the prospect of reward to, the exercise of countervailing power from the other side... The first begets the second..."[2]

Hog producers and producer organizations related to the industry began submitting marketing plans to the Alberta Department of Agriculture for approval in the early 1960s. In the fall of 1965, the newly appointed Marketing Council urged the organizations which had submitted plans to cooperate on a consolidated proposal acceptable to all sectors of the industry. No agreement on consolidation was made. The Marketing Council then advised all swine and farm organizations that the Minister of Agriculture had approved a proposal to have an opinion poll of hog producers concerning the type of marketing plan they favored. The organizations sponsoring three basic plans were the Western Hog Growers' Association, the Alberta Livestock Cooperative, and the joint organization of the Alberta Federation of Agriculture and the Farmers' Union of Alberta.[1]

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[1] G.B. Reschenthaler, "An Analysis of the Competitiveness of the Pork Industry in Alberta," presented to the Hog Marketing Review Committee, Edmonton, 24 June 1980, p. 9. (Mimeographed.)

[2] J.K. Galbraith, American Capitalism: The Concept of Countervailing Power (Boston, Mass.: Houghton Mifflin, 1952), pp. 111 and 113.

In the fall of 1968, the results of the opinion poll among hog producers indicated that the producers favored the joint F.U.A./A.F.A. proposal which called for the establishment of a Hog Marketing Board under which all slaughter hogs were to be sold through a single selling agency. The provincial government began action to make the Alberta Hog Producers' Marketing Board a reality and on October 31, 1969 the Board officially opened its telebid system of selling hogs.[2]

Since the Board's implementation, it has undergone various developments and policy changes. Some of these alterations include Board involvement in domestic and foreign contracts, insurance, price pooling, bid/acceptance selling system, promotional activities and court action against the packing plants. Table 2-3 summarizes the development and events which have affected the Board. Additionally, a general outline of events affecting the Board is summarized in the flow chart in Figure 2-8.

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[1] For a detailed description of the three marketing plans proposed and the development of the Board see M.H. Hawkins, et al., op. cit., 1977.

[2] Ibid.

TABLE 2-3

Chronology of the Development, Events and Policy Changes Affecting the Alberta Pork Producers' Marketing Board

DATE	STEPS TAKEN
1962	Plan for a hog marketing board was submitted to the Alberta Department of Agriculture by the Farmer's Union of Alberta (FUA) and the Alberta Federation of Agriculture (AFA).
1965	The newly appointed Alberta Agricultural Products Marketing Council urged all farm and swine organizations to cooperate in designing a consolidated plan which would be acceptable to a majority of hog producers.
November 1967	Marketing Council informed all swine and farm organizations that because the producer organizations could not agree to support any one plan, the Minister of Agriculture had approved a proposal to obtain an expression of opinion directly from hog producers as to which type of marketing plan they preferred.
June 1968	Cabinet approved the FUA-AFA Marketing Board plan, after the results from the producer opinion poll indicated its support.
October 31,1969	The AHPMB officially opened its telebid system and selling takes place using a Dutch-auction method of descending bids.
January 1972	The Board began publishing a magazine called the Alberta Hog Journal which was mailed to Alberta hog producers.
May 1973	The Board negotiated a contract with Japanese trading firms for 10,000 hogs over three years.
July 1973	Increasing costs of private insurance directed the formation of the Producers' Hog Indemnity Fund. Subscribing producers are sustained based upon fair market value of hogs during the period commencing with the loading of healthy hogs upon a transporting vehicle and terminating with the hog becoming the legal property of the purchaser.
1973	A program explaining proper methods of tattooing and its importance was initiated to ensure proper carcass identification providing both efficient movement of hogs and proper settlement to the producer.
1974	An amendment to section 2.1 of the Marketing of Agricultural products Act: Regulations relating to the procedure of the marketing of hogs resulted in the Board having the authority to offer hogs for sale by negotiating directly with a licensed processor or buyer of its choice as well as through the medium of the teletype system. The power of direct negotiation with a processor or buyer for the sale of hogs has been utilized on occasion of distress.
April 1974	The second contract with Japan was signed for 150,000 hogs over two years.
Spring 1975	A new selling system involving the use of six marketing terminals as flow control and hog collection points was established. Board terminals allow the supervision and the ability to influence hog flow to packing plants. The safety value of the terminal yards allows for greater flexibility and time to start and/or maintain markets at fair and reasonable prices.
January 1976	The third contract with Japan was signed for 48,000 hogs over two years.
April 1976	The fourth contract with Japan was signed for 360,000 hogs over three years.
August 1977	Marvin Moore, the Minister of Alberta Agriculture announced the appointment of an independent consultant, Dr. Hu Harries, to conduct a study and review on the hog price relationship.
November 1977	Hu Harries report completed and the major recommendations were: 1. Central problem is the inefficient plant sector. 2. Terms of reference be drawn up by department of agriculture and that invitations be extended to meat packers and other interested parties to submit proposals for new or remodelled hog processing facilities. 3. Subsidy be paid to producers during market reconstruction.
January 1978	Canada's hog grading system was changed which gave producers greater market flexibility. The new grid incorporated three specific changes. 1. The weight range for the linear fat-weight - index relationship was increased by 20 pounds (from 169-189 pounds.) 2. The reduction in index value which to date has applied to carcasses over 180 pounds, occurred at 200 pounds. 3. The weight class for index 100 carcasses was increased by 10 pounds in recognition of the increase in weight of the average carcass.
March 13, 1978	The Board implemented daily producer price averaging. Hog producers obtained a price which was the average weighted price of all domestic sales each day.
March 17, 1978	The Board started marketing hogs under the system of advance buyer bidding over the teletype. Producers have the opportunity to know the level of anticipated hog price before committing their hogs to market and strong satisfaction was received with the bid/acceptance system.
June 1978	The Board implemented a producer toll free code-a-phone market information service. This was a necessary part of the Board's new bid acceptance hog marketing system.

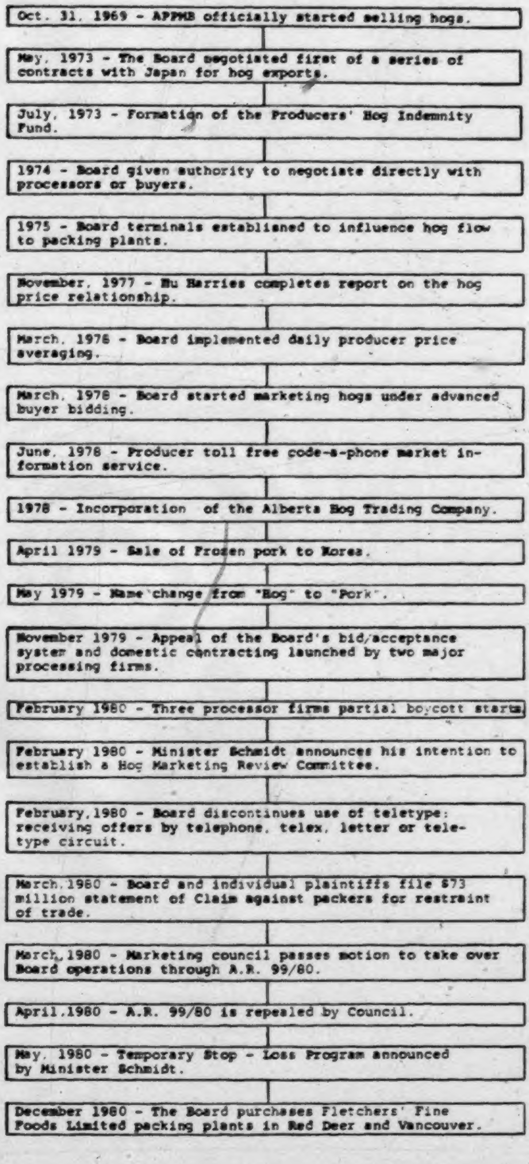
TABLE 2-3 (Continued)

DATE		STEPS TAKEN
June 1978	-	The Board established a Market Development Fund and allocated $400,000 to it. Those items which are considered to be one time, non-budgeted development type or new market development were assigned to this fund.
1978	-	The incorporation of the Alberta Hog Trading Company and its obtaining an Alberta livestock dealers license has reduced the financial risk that the hog producer and Board face when selling hogs out-of-province.
August and September 1978	-	The Board announces two sizable domestic hog contracts with Fletchers Fine Foods Ltd., and Burns Foods Ltd. Hog producers had the security and benefit of long term buyer commitment at formula price levels that were more stable and reflective of outside markets than in the past.
1978	-	Early development of several new promotional programs took place.
April 1979	-	The successful completion of a sale of 450 tonnes of western Canadian frozen pork to Korea was recently completed.
May 1979	-	The Alberta Hog Producers' Marketing Board assumed the new name, the Alberta Pork Producers' Marketing Board. The new name identified more strongly with the overall objective of expanding opportunities for the total consumption of pork.
Spring 1979	-	Pork promotion activities grow as the new radio jingle, "Put some pork on your fork"!! promotional barbeques and Alberta Pork logo stickers were presented in Calgary, Edmonton and Vancouver.
June 1979	-	The Board and two Alberta meat processors announced the successful completion of contract arrangements for a major pork export to Japan. Over a 20 month term, Gainers' Limited and Swift Canadian Co. Limited will process a total of 188,000 hogs for a Japanese trading company.
November 1979	-	The Board entered three new domestic contracts totalling approximately 150,000 hogs per year with Swift Canadian Co., Limited, Gainers' Limited, and Fletchers' Fine Foods Limited.
November 1979	-	An appeal of the Board's bid/acceptance system and domestic contracting was launched by two major multinational packing firms.
Spring 1980	-	For the first time, five major meat packers participated and helped fund an Alberta pork products promotion with the Pork Board.
February 1980	-	The APPMB excercised its power to set the range but not the price, by running a tape range to $54.50 (adjusted daily as markets changed). Two large packing firms protested by means of a partial boycott.
February 1980	-	Alberta Agriculture Minister Dallas Schmidt announced his intention to establish a committee to reveiw all aspects of hog marketing.
February 1980	-	The APPMB discontinued the use of the closed circuit teletype network dutch auction tape as a means to receiving offers for purchase. The Board started receiving buyer offers by telephone, telex, letter, or by the existing close circuit teletype network.
March 1980	-	In a Statement of Claim filed in Alberta Court of Queen's Bench, the Board alleged that price fixing, market sharing, and tampering with teletype auction equipment, among the packing firms unduly lessened competition for, and prices paid for slaughter hogs offered for sale by the Board since its inception. The claim seeks $73 million in damages.
March 1980	-	The Alberta Agricultural Products Marketing Council filed a regulation called Alberta Regulation 99/80. This effectively removed the operation of the APPMB from the producers' hands. Council takeover was not to be until October 1, 1980 but could have been earlier if the Board took any initiatives to improve Alberta's hog price. This threat rendered the Board ineffective as a marketer of hogs.
April 1980	-	The Council repealed Alberta Regulation 99/80 as amended. Council noted that Alberta Regulation 99/80 was not contributing to the resolution of hog industry problems.
April 1980	-	The establishment of a Council Committee, by the Alberta Government, to monitor and review the Board's marketing system. The Board supported this action and stated that if it had been ongoing, it could have prevented the errors which have occurred in the past.
May 1980	-	Temporary Alberta Emergency Stop - Loss Program for hogs was announced by the Honorable Dallas Schmidt, Provincial Minister of Agriculture. This program operated from April 1, 1980 to March 31, 1981 and guaranteed, through a formula, that producers would receive a minimum of $35 per hog above feed costs.
August 1980	-	Members of the Board of Directors of the APPMB visited two major packing plants in the U.S. corn belt. This tour was part of the Board's investigation of the meat system and possible options for Alberta producer involvement in future meat processing.
October 1980	-	Alberta Pork Producers' Marketing Board move into a new office building which they purchased in the fall of 1979.
December 1980	-	APPMB purchased Fletchers' Fine Foods Limited packing plants in Red Deer and Vancouver for $14.5 million. The packing operation will be controlled by a board appointed by the pork board delegates, with two representatives appointed by the Alberta government.
February 1981	-	The Hog Marketing Review Committee, with Jim Foster acting as chairman, completed their report on the hog marketing situation in Alberta. The major recommendations were directed towards the Alberta Department of Agriculture. Also, recommendation was made to establish a Hog Industry Committee, with objectives to strengthen the hog industry. This committee would include senior officers of the Marketing Board, processors, the Alberta Marketing Council and the Alberta Department of Agriculture.

Source: Alberta Pork Producers' Marketing Board. Alberta Hog Journal. Edmonton, Alberta: various issues 1977-1980. Title changed to Western Hog Journal summer of 1979.; M.H. Hawkins, et al., Development and Operation of the Alberta Hog Producers' Marketing Board. Rural Sociology Bulletin 12 (Edmonton: University of Alberta, March 1977).

Figure 2-8

Flow Chart Of Significant Events Affecting the Board



Oct. 31, 1969 - APPMB officially started selling hogs.

May, 1973 - The Board negotiated first of a series of contracts with Japan for hog exports.

July, 1973 - Formation of the Producers' Hog Indemnity Fund.

1974 - Board given authority to negotiate directly with processors or buyers.

1975 - Board terminals established to influence hog flow to packing plants.

November, 1977 - Hu Harries completes report on the hog price relationship.

March, 1976 - Board implemented daily producer price averaging.

March, 1978 - Board started marketing hogs under advanced buyer bidding.

June, 1978 - Producer toll free code-a-phone market information service.

1978 - Incorporation of the Alberta Hog Trading Company.

April 1979 - Sale of Frozen pork to Korea.

May 1979 - Name change from "Hog" to "Pork".

November 1979 - Appeal of the Board's bid/acceptance system and domestic contracting launched by two major processing firms.

February 1980 - Three processor firms partial boycott starts.

February 1980 - Minister Schmidt announces his intention to establish a Hog Marketing Review Committee.

February, 1980 - Board discontinues use of teletype: receiving offers by telephone, telex, letter or teletype circuit.

March, 1980 - Board and individual plaintiffs file $73 million statement of Claim against packers for restraint of trade.

March, 1980 - Marketing council passes motion to take over Board operations through A.R. 99/80.

April, 1980 - A.R. 99/80 is repealed by Council.

May, 1980 - Temporary Stop - Loss Program announced by Minister Schmidt.

December 1980 - The Board purchases Fletchers' Fine Foods Limited packing plants in Red Deer and Vancouver.

Source: Alberta Pork Producers' Marketing Board, Alberta Hog Journal, Edmonton, Alberta: various issues 1977-1980. Title changed to Western Hog Journal summer of 1979.; M.H. Hawkins, et al., Development and Operation of the Alberta Hog Producers' Marketing Board, Rural Sociology Bulletin 12 (Edmonton: University of Alberta, March 1977).

CHAPTER III

CONDUCT SUGGESTED AMONG OLIGOPSONISTS IN THE ALBERTA PORK PROCESSING INDUSTRY

INTRODUCTION

The purpose of this chapter is to present a theoretical background of concepts relating to the conduct and behavior of oligopolies. The pork packing industry in Alberta will be evaluated to determine how closely its conduct relates to some of the theories of oligopolistic conduct.

An overview will be presented which illustrates the general interdependence that exists between oligopolists. The structure of the Alberta pork packing industry will be reviewed. Some evidence of the firms' market conduct in this industry will be compared to the behavior expected among oligopolies. An attempt will also be made to use theoretical principles to explain why Alberta packers tend to follow particular types of conduct.

INTERDEPENDENCE OF OLIGOPOLISTS

Changes in the structure of an industry and structure itself are presumed to have an effect on conduct. For example, as the number of buyers or sellers in a market become fewer or more concentrated, the probability of independent action would appear to diminish. Effective price competition which is anticipated in a competitive market is also expected to decline. Cournot illustrated this pattern of behavior by stating that with a single seller, monopoly prices prevail and as the number of sellers increase the price approaches the firm's marginal cost.[1] Even though price is the most clear cut competitive technique for coordination, nonprice or quality competition (by adjusting trade agreements or by changing the product or through advertising and other actions) can have positive effects for the public though it is less direct.[2]

In a competitive market situation, the actions taken by one firm have little impact on the others. In an oligopoly situation the actions of one firm cannot be ignored, since each firm's behavior has a substantial impact on the others.[3] It is not, however, enough to distinguish an oligopoly from perfect competition or from a monopoly by the number of buyers or sellers alone. A further essential distinguishing feature is the interdependence of the various sellers' or buyers' actions. Generally accepted behavior features apply in monopolistic or perfectly competitive markets, but an oligopoly may show many behavior characteristics.[1]

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[1] F.M. Scherer, Industrial Market Structure and Economic Performance (Chicago: Rand McNally College Publishing Company, 1970), p. 132.

[2] William G. Shepherd, The Economics of Industrial Organization (Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1979) p. 301.

[3] G.B. Reschenthaler, op. cit., pp. 6-7.

If sellers are slow in perceiving their interdependence or commonality of interest, then havoc in the industry may develop through a price war. This tends to impress upon those firms not following the others, the merits of following the other firms. As the firms realize their interdependence on each other, some marketing strategies or tactics which are beneficial for the entire group are usually implemented. A major problem facing oligopolists in an industry is finding a mechanism for communicating and determining a compromise price or market share which is favorable for the group of firms.[2] This chapter will attempt to outline the mechanisms which may apply among the packing firms in Alberta.

MARKET STRUCTURE IN ALBERTA AND OTHER CANADIAN MARKETS

A market situation with a small number of buyers is similar to one with a few number of sellers. The term used for this situation is oligopsony[3] while the term used for a market with few sellers is oligopoly. The same behavior assumptions apply to both situations.

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[1] James M. Henderson and Richard E. Quandt, Microeconomic Theory (New York: McGraw-Hill Book Company, 1958), p. 222.

[2] G. B. Reschenthaler, op. cit., pp. 7-8.

[3] James M. Henderson and Richard E. Quandt, op. cit., p. 242.

Table 3-1 illustrates concentration ratios for hog purchases by the four largest pork packing firms in Ontario and the three prairie provinces for 1975 and 1976. Previous work by the Canadian Pork Council suggests that concentration in the hog packing plant industry is associated with economies of size.[1] This may explain to a certain degree why the prairie provinces' market structure is more concentrated than the much larger eastern Canadian markets.

TABLE 3-1

Market Share of Hog Purchases By the Top Four Pork Packing Companies In Selected Provinces, 1975 and 1976

Province	Share of Hog Purchases by Top 4 Companies	
	1975	1976
Ontario	61.3	64.4
Manitoba	80.5	82.9
Saskatchewan	98.3	100.0
Alberta	77.2	80.0

Source: Canadian Pork Council, Spatial Price Differences For Hogs in Canada (Ottawa, Ontario: March, 1979) p. 7.3.

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[1] Canadian Pork Council, op. cit., p. 7.6.

Presently, in Alberta the pork packing industry is highly concentrated as the five largest packers account for over 95 percent of hog purchases.[1] These packers sell a portion of their processed pork to a retail trade where one firm functions as a near monopolist, handling an estimated 60 to 70 percent of all pork products retailed in Alberta. Two other firms control the bulk of the remaining 30 percent of sales.[2] The packers purchase their hogs from eight to ten thousand individual producers marketing hogs through a single agency: the Alberta Pork Producers' Marketing Board. The Board's position would indicate a monopolistic situation, but the Board does not have the power to set prices or restrict the output of hogs which characterizes monopolists.[3] The Board acts as a mechanism for exchange, allowing the producers to receive bids from all the packing plants in Alberta.

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[1] Interview with Greg Whalley, Alberta Pork Producers' Marketing Board, Edmonton, 10 February 1981.

[2] James L. Foster, et al., The Hog Marketing Review Committee, a report prepared for the Honorable Dallas W. Schmidt, Minister of Alberta Agriculture, Edmonton, 20 January 1981, pp. 25 and 29.

[3] R.R. Russell and M. Wilkinson, Microeconomics a Synthesis of Modern and Neoclassical Theory (New York: John Wiley and Sons, 1979), pp. 251-257.

CONDUCT EXHIBITED IN THE ALBERTA PORK PROCESSING INDUSTRY

EVIDENCE ON COVERT AGREEMENTS

Covert agreements may be used by oligopolists to support prices higher than they would be under independent competitive conduct, or there may be collusive agreements to obtain monopoly prices and profits. Industrial organization theory indicates that the major procedures implemented in applying such agreements are price fixing, output limitations, market sharing, and maintenance of specific geographic areas regarded as each firm's exclusive sphere of interest.[1]

Market sharing by the Alberta pork processing plants is suggested by the data in Tables 3-2, 3-3, and 3-4 as the four major packers had fairly constant market shares throughout 1972, 1974, and 1976 with little variability. Packer B closed one of its packing plants in Calgary in 1975. Most of Packer B's market share in 1976 seemed to go to its other plant in Edmonton and also to Packer C. By contrast with the stability in market shares, the volumes purchased by the packing plants during the 3 years varied substantially, even though some of this variability could be accounted for by seasonality factors. However, the Board states that this

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[1] F.M. Scherer, op. cit., pp. 159-164.

TABLE 3-2

Market Shares and Volume Purchased Among the Four Largest Packing Firms in Alberta (1972)

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
PACKER A												
Market Share %	24.45	24.43	25.80	25.89	25.76	25.87	25.71	24.97	24.88	25.34	25.27	26.90
Volume Purchased	38,141	35,712	42,677	42,771	45,180	41,273	35,418	34,793	28,596	30,475	32,435	27,540
PACKER B												
Market Share %	17.37	17.02	18.59	17.53	17.76	17.14	17.58	16.02	17.24	17.04	16.90	16.33
Volume Purchased	27,101	24,897	30,765	28,979	31,154	27,358	24,487	23,205	19,821	20,492	21,693	16,712
PACKER C												
Market Share %	23.88	24.28	23.64	23.98	24.13	23.31	23.01	23.26	22.78	22.56	23.00	23.79
Volume Purchased	37,253	35,494	39,118	39,632	42,325	37,202	31,704	33,518	26,177	27,129	29,527	24,358
PACKER D												
Market Share %	9.22	9.78	9.81	10.09	9.59	9.67	9.25	10.23	9.51	9.56	9.64	8.62
Volume Purchased	14,388	14,300	16,237	16,672	16,823	15,425	12,747	14,251	10,934	11,501	12,376	8,827

Source: Information provided by Greg Whalley, Alberta Pork Producers' Marketing Board, Edmonton, June 1980 (Mimeographed.)

TABLE 3-3

Market Shares and Volume Purchased Among the Four Largest Packing Firms in Alberta (1974)

	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
PACKER A												
Market Share %	28.91	27.62	25.95	29.16	26.75	N.A.	N.A.	25.75	27.63	27.16	25.04	24.67
Volume Purchased	41,052	39,494	34,643	43,911	35,280	N.A.	N.A.	32,051	29,677	29,642	26,434	21,663
PACKER B												
Market Share %	14.34	16.31	17.29	17.28	18.24	N.A.	N.A.	15.63	15.12	16.97	17.71	16.83
Volume Purchased	20,362	23,061	23,081	25,556	24,065	N.A.	N.A.	19,455	16,237	18,528	18,698	14,780
PACKER C												
Market Share %	26.93	25.44	26.75	23.67	24.66	N.A.	N.A.	28.27	29.90	28.84	27.84	28.03
Volume Purchased	38,238	36,373	35,707	35,628	32,525	N.A.	N.A.	35,190	32,112	31,486	29,391	24,618
PACKER D												
Market Share %	9.05	7.69	9.15	8.83	6.82	N.A.	N.A.	5.35	6.02	6.53	7.11	8.30
Volume Purchased	12,843	10,989	12,216	13,291	8,994	N.A.	N.A.	6,656	6,470	7,129	7,512	7,287

Source: Information provided by Greg Whalley, Alberta Pork Producers' Marketing Board, Edmonton, 20 March 1981 (Mimeographed.)

TABLE 3-4

Market Shares and Volume Purchased Among the Four Largest Packing Firms in Alberta (1976)

	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
PACKER A												
Market Share %	27.27	27.30	26.72	27.69	27.69	27.17	25.64	28.50	28.93	27.42	26.68	28.14
Volume Purchased	21,495	19,029	22,734	20,710	20,018	19,345	16,742	20,476	19,757	17,718	20,809	19,527
PACKER B												
Market Share %	11.07	8.01	7.67	10.38	10.61	10.86	11.16	8.04	6.34	7.88	9.51	10.31
Volume Purchased	8,727	5,585	6,522	7,766	7,810	8,386	7,288	5,776	4,329	5,093	7,416	7,030
PACKER C												
Market Share %	30.67	32.04	33.04	30.75	30.76	31.07	30.82	32.63	31.51	33.47	32.28	30.34
Volume Purchased	24,172	22,332	28,110	22,999	22,664	24,000	20,118	23,445	21,522	21,633	25,176	21,057
PACKER D												
Market Share %	9.33	9.83	12.35	10.56	8.48	9.81	9.71	9.88	10.81	9.97	9.80	9.16
Volume Purchased	7,350	6,853	10,512	7,898	6,246	7,575	6,342	7,102	7,384	6,441	7,640	6,359

Source: Information provided by Greg Whalley, Alberta Pork Producers' Marketing Board, Edmonton, 20 March 1981. (Mimeographed.)

pattern of market share stability did not last throughout the 1970s but broke down after 1978 (perhaps due to the Board's introduction of domestic contracting and selling system changes). The evidence allows inference that stable market shares did exist from 1972 to 1976.[1]

The fact that market shares among the various packing plants remained fairly stable from 1972 to 1976 suggests that there may have been some mechanisms for communication between the packing firms. Some processors have felt that their efforts to increase their market share resulted in disciplinary actions from the more dominant firms. A letter dated September 25, 1978 by Mr. H. Ninke, the President of Grande Prairie Packers, to the Honorable Marvin Moore, the Minister of Agriculture, illustrates this point.

> Prior to July, 1977 our firm experienced some difficulty in obtaining the necessary supply of hogs for slaughter, which is unusual since the immediate area produces more than my slaughter requirement. I experienced situations where Edmonton packers paid much more for F.O.B. Grande Prairie hogs than they paid for Edmonton area hogs, and then these Edmonton packers had to pay transport costs to Edmonton. This situation was certainly not a reflection of any quality differential between Edmonton and Grande Prairie hogs. It is my view that such a phenomenon occurs to ensure that there is industry unanimity - that is, we all toe the line drawn by the largest of our peer groups. Apparently, my firm must

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[1] G.B. Reschenthaler, op. cit., p. 24.

> not grow, and certainly must not participate in the Edmonton market.[1]

The letter argues that the region of Grande Prairie was to be regarded as the sphere of interest for the Grande Prairie packer and this packer was restricted in its growth. It implies that the more dominant packers used disciplinary actions of price cutting as a mechanism to enforce this behavior. However, another possible reason for these price differentials is that Edmonton packers could have paid a premium for Grande Prairie hogs to reduce their firms' marginal costs of production. These reduced marginal costs of production may outweigh the additional price that Edmonton packers paid for the hogs. However, this economic reasoning is weakened by the constancy of market shares among the pork packing plants.

Agreements among firms to set and abide by particular prices is known as price fixing.[2] This behavioral procedure has been suggested by critics of the packing plant industry. In the past, many consecutive sales during a day have been at the same price. The Canadian Pork Council claims that this type of pricing practice was evident among the packers during seven different days during May and August of 1977. One example is provided in Alberta by the situation on August 22, 1977 when five packers bid on 31 consecutive sales at the same price and later on the same day 33 consecutive sales went at the same price.[1]

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[1] Ibid., pp. 30 and 31.

[2] F.M. Scherer, op. cit., p. 159.

Another of the Canadian Pork Council examples is given in Figure 3-1. This illustrates contrasts in the bidding patterns for Alberta and Ontario. On the day cited, the Ontario price was constantly fluctuating while the Alberta price was stable for many consecutive bids. Figure 3-1, which is fairly representative of other observations, suggests that the Ontario hog price was determined somewhat competitively while the Alberta hog price seemed to be the result of oligopsonistic behavior among buyers.[2] This is strengthened by observation of Table 3-1 which illustrates a higher concentration ratio in Alberta than Ontario among the four largest hog packing plants. In 1977, Ontario had 12 federally inspected hog slaughtering plants, while Alberta had only 7 federally inspected hog packing plants.[3]

PRICE LEADERSHIP

Price leadership is a type of conduct which some critics have argued was displayed in the packing industry. Price leadership involves list price changes which are normally announced, or in some manner exhibited, by a specific firm

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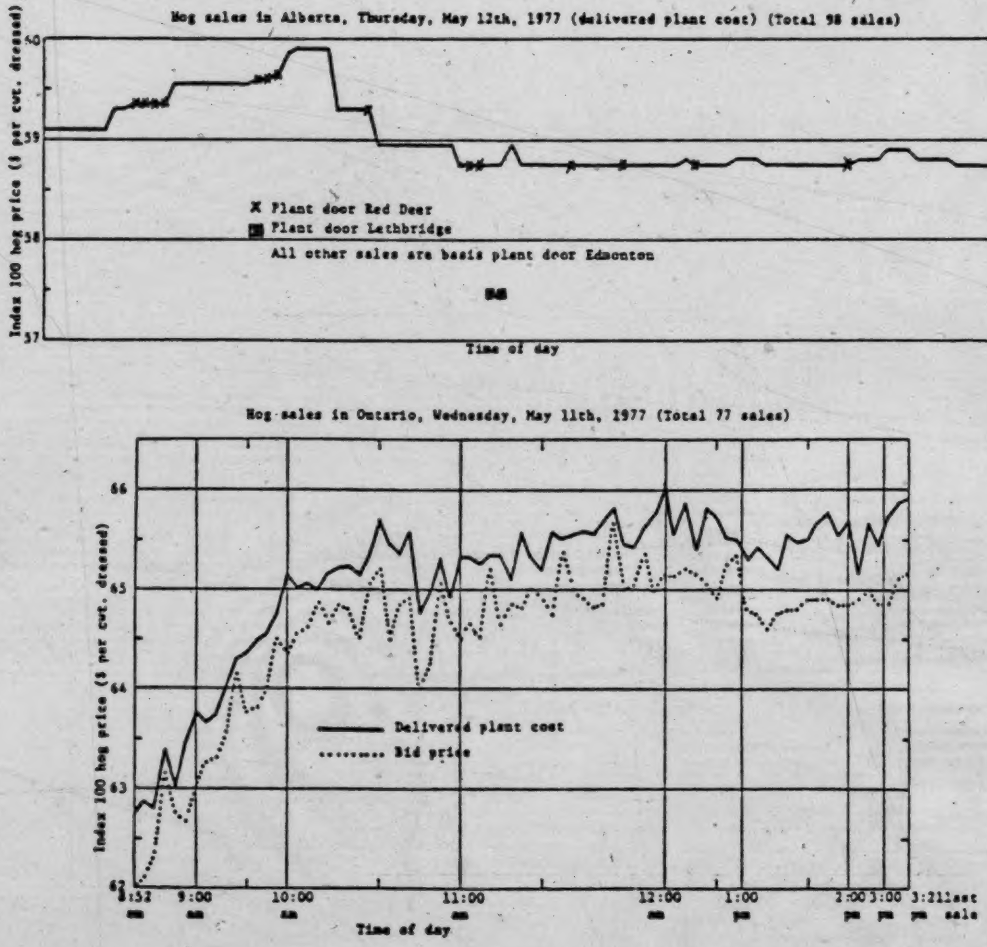
[1] Canadian Pork Council, op. cit., pp. 7.10-7.17.

[2] G.B. Reschenthaler, op. cit., p. 26.

[3] Howard Fredeen, op. cit., Table D12.

FIGURE 3-1

Contrast in the Bidding Pattern for Hogs, Among Packing Plants Between Alberta and Ontario



Hog sales in Alberta, Thursday, May 12th, 1977 (delivered plant cost) (Total 98 sales)

Hog sales in Ontario, Wednesday, May 11th, 1977 (Total 77 sales)

Source: Canadian Pork Council, *Spatial Price Differences for Hogs in Canada* (Ottawa, Ontario: March, 1979), pp. 7.13 and 7.19.

accepted as the leader by others who generally follow the leader's initiatives. There are three main types of price leadership; dominant firm leadership, collusive leadership and barometric leadership. Price leadership is referred to as collusive if it facilitates monopoly pricing, while it is called barometric if it does not.[1] The type of price leadership applying to the packing plant industry tends to be barometric price leadership with two main behavior traits. The identity of the price leader occasionally changes and the price leaders are not always followed.

A recent study of the Alberta hog industry displays an example of the bidding pattern between the 5 major packing plants in Alberta during the period from February 4 to April 10, 1980 (Table 3-5). Packers A and B were usually the lowest bidders during this time period. With the Board's selling procedures the buyers should not know the identity of the purchaser of any given lot and the author of this study has argued that it is unlikely that the bidding pattern of Table 3-5 emerges by chance.[2] It is possible that packers A and B, who are larger packing firms than the others, wait until the smaller processors complete their hog purchases for the day at a higher price, then purchase

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[1] F.M. Scherer, op. cit., pp. 164-173.

[2] G.B. Reschenthaler, op. cit., p. 26.

TABLE 3-5

Packer Bid Rankings Among the Five Largest Hog Packing Plants in Alberta (1980)[1]

	Days when highest bidder	% of total days	Days when 2nd highest bidder	% of[2] total days	Days when lowest bidder	% of[2] total days	Days when 2nd lowest bidder	% of[2] total days
PACKER B	1	3.0	1	3.3	5	16.7	14	46.7
PACKER C	13	39.4	13	43.3	0	0	1	3.3
PACKER A	0	0	1	3.3	20	66.7	6	20.0
PACKER E	12	36.4	7	23.3	4	13.3	4	13.3
PACKER D	7	21.2	8	26.7	1	3.3	5	16.7

[1] Period February 4 to April 10. Total 48 days. The rankings were made for the 33 of those days when all 5 plants actively bid for hogs.

[2] Total days = 30. 3 of the 33 days excluded because of a three way tie for second.

Source: G.B. Reschenthaler, "An Analysis of the Competitiveness of the Pork Industry in Alberta," paper presented to the Hog Marketing Review Committee, Edmonton, 24 June 1980, p. 24a. (Mimeographed.)

the residual hogs to meet their needs at a lower price. In an oligopsonistic situation, this type of bidding scheme could be expected to emerge.

RULE-OF-THUMB PRICING

"Rule-of-thumb" pricing and "cost-plus-markup" pricing involves the practice of adding a normal or desired profit margin or percentage return on invested capital to estimated unit costs to calculate the product price. There are many reasons for firms in concentrated industries to use this mechanism for pricing decisions. It copes with uncertainties in the estimation of demand function shapes and elasticities, enhances fairness and simplifies the pricing problems of firms that sell hundreds of items with considerable turnover.[1] Markups provide a tool for maximizing profits which can be adjusted, varied, or departed from, whenever conditions warrant.[2]

The margins between producer and wholesale pork prices in Alberta-British Columbia are larger than in the American Pacific northwest and eastern Canada.[3] A previous study concluded that adequate explanation of the differences in margins could not be found in cost differences and the question was raised as to whether these larger margins are related to the higher concentration of packing plants in western Canada.[1] Producers generally perceive that the pork processors set their wholesale price, calculate revenue from the cut-up hog, subtract a desired operating margin with the result being the amount they will pay for hogs.[2] "A firm in a competitive market cannot affect the hog price. If it finds itself underutilizing its plant capacity it will have to take some losses. It should not be able to cause a drop in the hog price to cover the costs incurred by underutilization of capacity."[3] The statements above give little evidence but some indications of cost-plus-markup pricing are given.

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[1] F.M. Scherer, op. cit., pp. 173-178.

[2] William G. Shepherd, op. cit., p. 299.

[3] Reg Norby, "Western Hog Journal," Alberta Pork Producers' Marketing Board, Edmonton, 1977-1980, various issues.

REASONS ALBERTA PACKERS MAY ADOPT CERTAIN TACTICS OF CONDUCT

There are some indications that at times the practices of covert agreements, price leadership, and rule-of-thumb pricing were displayed in Alberta by the packing plant industry for pork. These tactics of conduct could have been adopted by the packing plants because of the nature of the product. Live hogs can be considered a homogeneous product which is hard to differentiate. Most of the types of conduct discussed in this chapter more generally apply to markets with homogeneous products. Even though market sharing may apply for differentiated products, it can also be used with homogeneous products.[1] It may be that the Alberta packers realized their interdependence and adopted those marketing strategies or tactics which were beneficial for the entire group of firms. Further, the packing plant industry might have used the above areas of conduct to avoid a price war and havoc in the industry.

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[1] Canadian Pork Council, op. cit., pp. 3.1-3.12.

[2] G.B. Reschenthaler, op. cit., pp. 20-21 and A.W. Wood, "Consumer Interest in Hog Marketing Boards," report prepared for the Canadian Consumer Council, Ottawa, Ontario, March 1974, p. 11. (Mimeographed.)

[3] Canadian Pork Council, op. cit., p. 8.12.

CONCLUSIONS

The packing plant industry for pork in Alberta is highly concentrated. This may provide the situation for individual packers to engage in interdependent actions. Some of the behavior patterns of the packers seem to relate to some of the theories of oligopolistic conduct.[2] Because of the nature of the product, the packing plants may tend to adopt certain tactics of conduct.

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[1] James M. Henderson, op. cit., p. 223.

[2] An earlier study by Eastman and Stykolt concluded that the beef and pork packing industries were highly competitive. Attempts at price leadership were generally ineffective, market shares varied substantially over time, and there was no evidence of collusion. However, it should be noted that their study mainly assessed aggregated Canadian data and the packing industry has become much more concentrated in the past twenty years, especially in western Canada. H.C. Eastman and S.Stykolt, The Tariff and Competition in Canada (Toronto: Macmillan of Canada, 1969), pp. 303-309.

CHAPTER IV

A SELECTED REVIEW OF THEORETICAL CONCEPTS AND EMPIRICAL STUDIES

INTRODUCTION

Various theoretical approaches for analysis of market performance have been developed. As well, empirical studies of marketing efficiency have been made. After a review of the literature, principles were selected to serve as a foundation for analysis of the market performance of the Alberta Board. A summary of the review is presented in this chapter.

THEORETICAL CONCEPTS

EVALUATION OF MARKET PERFORMANCE

In appraising market performance, Low states that, "two general approaches struggle for supremacy in industrial organization. Traditionalists usually favor criteria based on the degree to which markets contribute toward an ideal allocation of resources." The other general approach to performance standards is an assessment of how well the markets rate according to desirable criteria of individual firms and the economy.[1] Bain defines market performance as "the indicator and measurement of how well the market activity of enterprises contribute to the general material welfare of the economy."[1] Caves supports this approach by specifying four goals that an economy should attempt to achieve if it is to "provide the maximum economic welfare for its citizens. It should be efficient... progressive... fully employed... and equitable."[2] This criteria can be assessed by analyzing the actual behavior of an industry or the economy in relation to some performance measures.[3] There exists a concensus among several authors that the perfectly competitive (efficiency) model provides a standard for comparison in evaluating actual market situations.[4] When the positive (what is) and normative (what ought to be) differ, possible areas of choice or areas of improvements are indicated. Williams and Stout give some general guidelines for improved efficiency: (1) More competition, (2) fewer barriers and restriction to entry, (3) more information and equity of information, (4) standardization, (5) rules specified and enforced.[1]

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[1] Richard E. Low, Modern Economic Organization (Homewood, Illinois: Irwin, Inc., 1970), p. 295.

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[1] Joe S. Bain, op. cit., p. 340.

[2] Richard Caves, American Industry: Structure, Conduct, Performance (Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1977), p. 66.

[3] G.B. Reschenthaler, op. cit., p. 3.

[4] John M. Clark, Competition as a Dynamic Process (Washington, D.C.: The Brookings Institute, 1961), pp. 272-277.; Paul Farris, Market Structure Research (Ames, Iowa: Iowa State University Press, 1964), p. 149.; R.L. Kohls, "Toward A More Meaningful Concept of Marketing Efficiency," Journal of Farm Economics, Vol. 38 (February 1956), p. 70.; R. Bressler and R. King, Markets, Prices, and Interregional Trade (New York: John Wiley and Sons, 1970), p. 413.

Clodius and Mueller point out that practically all modern industrial markets seriously violate the assumptions of pure competition. Thus the competitive norm becomes an unattainable ideal.[2] Some economists such as Sosnick advocate the more realistic but less precise norm of "workable" or "effective" competition.[3] Sosnick maintains that

> ...a market is effectively competitive if and only if it is free of 25 flaws: unsatisfactory products, underuse or overuse, inefficient exchange, inefficient production, bad externalities, spoliation, exploitation, unfair tactics, wasteful advertising, irrationality, undue profits or losses, inadequate research, predation, preemption, tying arrangements, resale price maintenance, refusals to deal, undesirable discrimination, misallocation of risk, undesirable mergers, undesirable entry, misinformation, inefficient rules of trading, and misregulation.[4]

Sosnick's criteria tend to have many limitations when evaluating market performance of an industry. The time and cost involved to analyze each criterion could be beyond anticipated benefits. Using words such as: inefficient, bad, unfair, inadequate and undesirable open the way for value judgements. He also considers a market effectively competitive only if it is free from all twenty-five flaws. This would imply, as with the perfectly competitive model, that no market is effectively competitive.

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[1] W.F. Williams and T.T. Stout, op. cit., p. 146.

[2] Robert L. Clodius and Willard F. Mueller, "Market Structure Analysis an Orientation for Research in Agricultural Economics," Journal of Farm Economics, Vol. 43, No. 3 (August 1961), p. 523.

[3] Stephen Sosnick, "Toward a Concrete Concept of Effective Competition," American Journal of Agricultural Economics, Vol. 50, No. 4 (November 1968), pp. 827-854.

[4] Ibid., p. 827.

OPERATIONAL AND PRICING EFFICIENCY

Most of Sosnick's criteria for an effectively competitive market can be classified as specific parameters of operational and pricing efficiency. Williams and Stout declare that an operationally efficient market occurs when the output of useful marketing services is large relative to inputs in labor, capital, and other resources utilized in marketing.[1] Increased operational efficiency as further defined by French is, "to add, ... the conventional form, time, and place utilities to raw farm products through assembly, processing, storing, transportation, distribution and similar operations."[2]

An examination of the alternative costs involved through different marketing mechanisms, provides a method for evaluating operational efficiency as discussed by Tomek and

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[1] W.F. Williams and T.T. Stout, op. cit., p. 121.

[2] Ben C. French, "The Food Marketing Commission and Marketing Efficiency," Journal of Farm Economics, Vol. 29, No. 2 (May 1967), p.426.

Robinson.[1] Low also states that

> ... one can judge market efficiency in terms of x-efficiency; that is, in terms of cost minimization under the same scale and state of technological knowledge. This is difficult in practice, since it usually requires comparison of what is with what is not. But costs in comparable firms or two time periods might be compared.[2]

Clark implies that the mechanism utilized by buyers and sellers in trying to get the best terms the market offers is market information[3] which assists in the reduction of marketing costs. This may improve operational efficiency in several different ways: reducing uncertainty and physical handling costs, stabilizing costly maladjustments in supply and demand and maintaining constant pressure of competition provided by accurate knowledge, which is the most important cost-saving effect.[4]

> The efficiency of a pricing system depends, in part, on how rapidly and accurately markets evaluate pricing information and how accurately and rapidly this information is transmitted to buyers and seller in the market, to other markets, forward to consumers, and backward to producers.[5]

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[1] W.G. Tomek and K.L. Robinson, "Agricultural Price Analysis and Outlook," In a Survey of Agricultural Economies Literature, Edited by Lee R. Martin (Minneapolis: University of Minnesota Press, 1977), p. 381.

[2] R.E. Low, op. cit., p. 321. For further discussion read: William G. Shepherd, op. cit., pp. 378-380.

[3] John M. Clark, op. cit., p. 108.

[4] W.F. Williams and T.T. Stout, op. cit., p. 447.

[5] Ibid., p. 122.

According to Low the greater the availability of market information and the lower the cost of acquiring such information, the more rapid the adjustments tend to be to demand and supply conditions.[1]

Operational efficiency leads to lower costs of marketing, while pricing efficiency requires these cost savings to be passed on to the farmer in the form of higher producer prices.[2] Williams and Stout indicate further that

> ... there should be a compromise of some sort between the twin goals of operational and pricing efficiency. Optimum pricing efficiency would lead to a large number of firms equalizing the distribution of knowledge and information, but the costs involved might be prohibitive. On the other hand, attempts by individual firms to maximize operational efficiency can lead to monopolistic or discriminative pricing. An acceptable compromise, which might be referred to as workable or effective performance sometimes is selected as a standard of reference.[3]

MARKET STRUCTURE-CONDUCT-PERFORMANCE

Market structure and conduct are suggested by industrial organization theory as being prime determinants of the performance of an industry.[4] Bain summarizes the most important structural characteristics as: "the number of sellers or buyers; their relative sizes -- market shares; the conditions or barriers to entry; and, the characteristics of the product."[1] Scherer defines the aspects of conduct as "pricing behavior, decisions concerning product variety and quality, and innovation."[2]

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[1] R.E. Low, op. cit., p. 302.

[2] W.F. Williams and T.T. Stout, op. cit., p. 122.

[3] Ibid., p. 125, For further discussion on the tradeoff between operational and pricing efficiency refer to: A.A. Warrack, "A Conceptual Framework for Analysis of Marketing Efficiency," Canadian Journal of Agricultural Economics, Vol. 20, No. 3 (November 1972, pp. 13-19.

[4] For further readings on this subject see Richard Caves, op. cit., pp. 17-82; James V. Koch, Industrial Organization and Prices (Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1980), pp. 190-209; F.M. Scherer, op. cit., pp. 400-412.

It is a difficult task to identify links between market structure, conduct and performance. As stated in a U.S. Department of Agriculture publication: "economic theory... provides no basis for positing the form of the relationship. Is it linear, curvilinear, monotonically increasing, or something else?"[3] Owing to this difficulty, Bressler and King suggest that in agricultural markets the connections between market structure and performance are often too tenuous to be of value. They urge a reverse approach: first to study market performance, then make connections with institutional factors referred to as structure.[4]

APPLICATION TO THIS STUDY

Considering the difficulty in determining the connection between market structure, conduct and performance this study will evaluate market performance during different time periods which represent major policy changes of the Board. Explanations will be sought for any relationship between these policy changes and market performance.

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[1] Joe S. Bain, op. cit., pp. 145-423.

[2] Scherer, op. cit., p. 131.

[3] U.S. Department of Agriculture, Market Performance: Concepts And Measures, Agricultural Economics Report No. 244 (Washington D.C.: Government Printing Office, 1973), p. 31.

[4] R. Bressler and R. King, op. cit., p. 73.

Since absolute norms are difficult to define, this study followed the suggestion of a U.S.D.A. publication that "the performance of other industries, or of the same industry in previous time periods are frequently used benchmarks."[1] A basic norm or standard for comparison will be the average price of live hogs for the U.S. 7 markets.

The analysis of price differentials between market areas will be evaluated following the criteria of Bressler and King: "an efficient market will establish prices that are interrelated through space by transportation costs, through form by costs of processing, and through time as a consequence of the storage costs."[2] Following the perfectly competitive model one expects that prices are generally lowest in areas where available supplies relative to consumption are most heavily concentrated.[3]

A subjective approach to assess improved market information after the Board's formation will be used in this study. The Board's operational efficiency and pricing efficiency, from the producer to the packing plant level of marketing, will also be assessed through qualitative and quantitative analysis.

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[1] U.S. Department of Agriculture, op. cit., p. 23.

[2] R.Bressler and R. King. op. cit., p. 413.

[3] W.F. Williams and T.T. Stout, op. cit., p. 587.

SELECTED REVIEW OF EMPIRICAL STUDIES

There is an array of empirical studies concerning various aspects of market performance. Almost every sector of the U.S. economy has been evaluated, either qualitatively or quantitatively, to ascertain production and marketing efficiency. Some of these sectors of the economy include government agencies, company managers, industrial organization economists, market participants, prospective entrants to an industry and individual investors.[1] Other countries, specifically Canada, have been evaluated for economic efficiency but to a lesser degree.

The empirical studies noted and assessed will be limited to the agricultural sector and, more specifically, to the influences of market institutions on performance. There will also be some appraisal of studies analyzing spatial location and its impact on price differentials between markets.

The first general study on pricing efficiency was accomplished by Hassler in 1953. He evaluated the dairy products industry for the United States by determining the market which would represent the base price with other market prices related to it. With the selected markets chosen, the price differences that should have been expected between the various markets were calculated by allowing for transfer costs. Comparison of expected and actual average price differences were made in order to judge the spatial efficiency of the product markets.[1] "Although some persistent inconsistencies in the price relationships of the manufactured dairy products industry were disclosed, much of the evidence suggested that the pricing mechanism was remarkably compatible with a competitive system."[2]

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[1] U.S. Department of Agriculture, op. cit., 1973, p. 27.

A study completed by Ulrich in 1964 used statistical analysis to determine the effects of differences in the level of competition among four distinctive marketing channels for cattle in Manitoba. His analysis ascertained the mean differences and standard deviation and applied the t-test to differences in price levels between the four marketing channels. Results indicated a difference in the competition level between the various channels of marketing.[3]

In 1966, Jenson evaluated the performance of livestock marketing in Alberta using a qualitative approach following

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[1] James B. Hassler, "Pricing Efficiency in the Manufactured Dairy Products Industry," Hilgardia, Vol.22, No. 8 (1953), pp. 235-334. (Mimeographed.)

[2] *Ibid*., p. 319.

[3] Martin A. Ulrich, "Price Differentials Between Selected Channels of Marketing," *Canadian Journal of Agricultural Economics*, Vol. 12, No. 2 (1964), pp. 62-69.

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the criteria given by Sosnick and Caves as a standard for comparison. He indicated that improvements could be made in transportation cost savings by a reduction in the number of livestock exchanges, a general acceptance of the auction method of selling, and by improved market information and dissemination.[1]

One year later, Lockhart also analyzed the performance of the hog industry in Alberta using a subjective approach of determining goals for the industry and society and then evaluating the extent to which these goals were achieved.[2] He concluded that inadequate performance was displayed in three functions; "(1) the establishment of the sale price, (2) assembly and movement of the hogs to the meat packing plants from the farms, and (3) the collection of sufficient accurate data on market conditions and dissemination of the information in meaningful and usable form to the industry."[3]

In 1967, prior to the establishment of the Alberta Pork Producers' Marketing Board, Manning evaluated the performance of the hog marketing system in Alberta. He concluded that market performance was inadequate due "to the unequal distribution of market power, inadequate competition in establishing hog prices, excessive marketing costs and charges, and excessive variations in prices received by producers."[1] Recommendations were made for upgrading the system by "improvements in the present system, a new hog marketing program, or a new meat marketing program."[2]

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[1] Paul A. Jenson, "Country Livestock Auction Markets and the Structure, Conduct, and Performance of the Alberta Livestock Markets" (M.S. Thesis, Department of Agricultural Economics, University of Alberta, Edmonton, September 1966), pp. 51-60.

[2] James W. Lockhart, *op. cit*., p. 47.

[3] *Ibid*., p. 62.

A study completed in 1968, by Lele, considered the high degree of interdependence between jowar markets of India in the process of price formation. Lele analyzed market integration by evaluating the correlation coefficients between two markets. There was a high correlation between prices which supported the hypothesis that these agricultural markets were fairly competitive and that price movements in one market are influenced by price in other markets.[3]

In 1971, Andersen evaluated the Alberta hog industry using various techniques. Intermarket price spreads were examined for the Edmonton, Winnipeg and Toronto markets and these price differentials were analyzed graphically and statistically. He concluded that the level of freight rates did not totally account for the price spreads and suggested that each market operate independently of one another and should be treated as regional markets.[1]

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[1] Travis W. Manning, op. cit., p. 24.

[2] Ibid., p. 24.

[3] Uma J. Lele, "The Traders of Sholpur," in John W. Mellor, et al., Developing Rural India, Plan and Practice (Ithaca, New York: Cornell University Press, 1968), pp. 257-270. (Mimeographed.)

Ikerd, in 1971, applied location analysis to determine how the change from a net import to net export position affected the price of hogs in North Carolina. Irkerd hypothesized that if North Carolina imported pork from the Midwest, its price should be equal to the Midwest price plus transfer costs. If North Carolina was a net exporter of pork to the Midwest, the hog price in North Carolina should be equal to the Midwest price minus transfer costs. The results from the study supported the hypothesis that price differences are positively related to quantities imported and negatively related to quantities exported.[2]

The objective of the Trierweiler-Hassler study, published in 1971, was to evaluate specific price relationships of the beef-pork sector in the U.S. and to determine areas of inefficient production and marketing performance from the resulting price evidence. A standard of comparison used in this study was the long-run competitive equilibrium resulting from price levels and differentials in space, form, and time utilities. For this study constant transfer costs for 1957-1966 were assumed to simplify the evaluation. This could distort the relationships of the major forces involved in pricing but had the expected advantage of greater clarity and workability. The price for slaughter hogs on the Omaha market served as the norm. Transportation cost differences were represented by the value of the constant terms. The differences in price between locations should be equal to the differences in transportation costs between these locations and Omaha. The values of the coefficients of determination (R^2) were all close to one, leading the authors to conclude that strong competitive forces existed in the bidding for slaughter hogs.[1]

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[1] Richard S. Andersen, op. cit., pp. 50-57.

[2] John Ikerd, An Economic Comparison of Midwest and North Carolina Hog Prices, Economics Information Report No. 23 (Raleigh, North Carolina: North Carolina State University, June 1971), pp. 9 and 24.

In 1974, Thakur used the same type of analysis as in earlier studies by Lele[2] and Hassler.[3] Thakur evaluated pricing efficiency of the food grain marketing system in India by analyzing price trends in different markets, market integration and the price spreads in the marketing channel. The trend in prices for the different sample markets were analyzed using regression analysis. The results indicated that the trends in foodgrain commodities were not the same in all markets. Thakur states that "the degree to which wholesale prices of a commodity in different markets are related to each other is the most important consideration in determining the pricing efficiency of a marketing system."[1] The degree of market integration was determined by calculating correlation coefficients between prices in these markets. Analysis of pricing efficiency, by evaluation of market integration, indicated that the foodgrain marketing system was inefficient. The reason for this seemed to be the high degree of concentration among the traders, who may have agreed through mutual understanding or collusion to avoid price competition.[2]

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[1] T.E. Trierweiler and J.B. Hassler, "Measuring Efficiency in the Beef-Pork Sector by Price Analysis," Agricultural Economics Research, Vol. 23, No. 1 (January, 1971), pp. 11-17.

[2] Uma J. Lele, op. cit., pp. 257-270.

[3] James B. Hassler, op. cit., pp. 235-334.

In 1977, Fredeen prepared a study on the Canadian pork industry for Agriculture Canada. Regional hog price differences for the major Canadian and U.S. markets were analyzed. The study used, as a base price, the Omaha weekly average hog price (carcass basis) adjusted for monetary exchange rate, tariff and transportation costs. These price differentials were compared to the export surplus or deficit position for each region. This information was used to infer whether an accurate reflection of demand and supply conditions was transmitted through prices.[1] Fredeen concludes by stating that "the widely erratic behavior of western pig prices relative to Toronto denys any meaningful interpretation on the basis of transportation costs."[2]

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[1] D.S. Thakur, "Foodgrain Marketing Efficiency: A Case Study of Gujarat Bombay, India," Indian Journal of Agricultural Economics, Vol. 29, No. 9 (1974), p. 66.

[2] Ibid., pp. 66-70.

In 1977, the Provincial Minister of Agriculture directed Hu Harries and Associates Ltd. to "review the price relationship which should exist between Alberta and other North American points regarding the price of Alberta hogs at both the producer and wholesale levels."[3] This study utilized graphical analysis to illustrate the price of hogs at Toronto, Winnipeg and U.S. market points expressed as percentage of the Edmonton hog price. Major recommendations of this study inferred that the Alberta hog price should be "plus or minus 5 percent of the adjusted Sioux City price"[4] depending upon Alberta's surplus or deficit position. Since the Alberta market was no longer in a surplus position, this study recommended that the traditional argument, suggesting the Edmonton hog price is below the Toronto price by the cost of freight, be eliminated.[1]

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[1] Howard Fredeen, op. cit., pp. 1-4. Appendix E.

[2] Ibid., p. 4. Appendix E.

[3] Hu Harries and Associates Ltd., "Price Relationships in the Alberta Hog Market," a study commissioned by Honorable M. Moore, Minister of Agriculture Government of Alberta (Edmonton, Alberta: October, 1977), p. 2.

[4] Ibid., p. 18.

The claim that marketing boards enhance stability was evaluated by Martin and Warley in 1978. To test this hypothesis, Martin and Warley examined the variation in four market variables: "industry output, producer price, industry gross revenue, and consumer price for five commodities, pork, tobacco, chicken broilers, turkeys, and eggs." Each set of data (representing Canada or eastern Canada depending on the commodity) was broken into two time periods reflecting major institutional changes and compared with the U.S. average for the similar time period. For each commodity and time period, means and standard deviations of the data were calculated and "subjected to t- and F- tests to determine whether significant differences existed between periods and countries."[2]

Recently, in 1980, Veeman and Veeman completed a similar study analyzing enhanced stability resulting from the implementation of marketing boards. The Veeman and Veeman commodity group included only chickens, turkeys and eggs and used provincial price data instead of aggregated national data for Canada. Real prices were determined by deflating the price series using the consumer price index (1971 = 100).

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[1] Ibid., pp. 18-26.

[2] Larry J. Martin and T.K. Warley, "The Role of Marketing Boards in Stabilizing Commodity Markets," American Journal of Agricultural Economics, Vol. 60, No. 5 (December 1978), pp. 878-879.

The means, standard deviation, and coefficient of variation were then calculated. The trend corrected standard deviations and coefficients of variation were calculated when a significant trend was evident.[1]

These two studies which analyzed whether market stability was achieved by marketing boards, reached similar conclusions. Martin and Warley could not prove that marketing boards enhanced stability.[2] Veeman and Veeman reported modest reductions in the fluctuations of prices, production, and revenue resulting from the inception of marketing boards.[3]

In 1979, the Canadian Pork Council completed a study which attempted to analyze the spatial price differences for hogs in Canada. Previous work done by Ikerd in the U.S.A.[4] identified the production-consumption balance of a region as an important factor in evaluating regional hog price differentials. The Council used this same type of analysis to relate the hog price differentials, between each major Canadian market and the U.S. average price, to the production-consumption balance for each region in Canada. The analysis also related the hog price differentials between markets in Canada to the production-consumption balance for various regions of Canada. The Pork Council found a strong relationship between the Canadian and U.S. price differential when related to production-consumption balances for pork in the regions of Canada.[1]

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[1] M.M. Veeman and T.S Veeman, op. cit., pp. 36-54.

[2] Larry T. Martin and T.K. Warley, op. cit., p. 883.

[3] M.M. Veeman and T.S. Veeman, op. cit., pp. 53-54.

[4] John Ikerd, op. cit., pp. 5-25.

A recent study in 1980, by Tomek, evaluated the price behavior of choice steers in the Denver terminal market compared to prices in the Omaha market. Weekly data were used and the means, standard deviations, and coefficient of variation were computed. Simultaneous regression models were also used in the analysis and emphasis was placed on descriptive statistics. Results indicated that precision of pricing in Denver was influenced by declining market volume.[2]

APPLICATION TO THIS STUDY

Statistical analysis will be implemented in this study to test the hypothesis of improved pricing efficiency after the Board's inception. The technique employed will be quite similar to that employed in the Veeman and Veeman study and the recent Tomek study. This analysis will also ascertain the degree to which prices in different markets are related to each other as was suggested by Thakur and Lele. Additionally, the Trierweiler and Hassler study will form a basis for the statistical analysis.

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[1] Canadian Pork Council, op. cit., pp. 6.1-6.6.

[2] William G. Tomek, "Price Behavior on a Declining Terminal Market," American Journal of Agricultural Economics, Vol. 62, No. 3 (August 1980), pp.434-444.

The same type of analysis as Andersen, Ikerd, and the Canadian Pork Council used in their studies of the hog industry will be implemented as well. The U.S. hog price will be used as a norm and the price differential analysis will be separated into different time periods representing the inception of the Board and its major institutional changes.

The Jenson and Lockhart studies were completed before the implementation of the Board. A similar qualitative approach will be utilized to determine if improved market information and reduced marketing cost have occurred since the Board's inception.

CRITERIA AND PROCEDURES TO EVALUATE MARKET PERFORMANCE

Based on the preceding literature review of selected theoretical concepts and empirical studies, a summarized list of criterion and procedures to evaluate the market performance of an industry could include the following:

1) Analysis of price differentials, graphically and statistically, between different markets can be applied.
2) Regression analysis and dummy variables may be implemented to test for distinct institutional and structural changes.
3) A qualitative and subjective assessment to determine improvements and proper dissemination of market information may be followed.

4) Market structural analysis with special emphasis on concentration, market share stability and the bidding patterns of buyers can be used.

5) Marketing costs in standardized firms or two time periods can be compared.

6) A norm such as the workable competitive model can be used as a standard for comparison.

7) Goals for the industry and society are determined and then evaluation is made of the achievement of these goals through a subjective approach.

CHAPTER V

METHODOLOGY

INTRODUCTION

In this chapter, the choice of market areas will be described and the sources of data collection outlined. The approach taken in this study in order to assess operational efficiency is elaborated upon, together with an examination of the models for testing pricing efficiency.

CHOICE OF MARKET AREAS

This study dealt with the marketing and in particular the pricing of hogs from producer to processor in the Alberta, Manitoba, Ontario and U.S. market areas. Alberta was the market under study, while the other three markets were included for comparative purposes. Manitoba and Ontario have provincial marketing boards much like that in Alberta. After each Board was established, all hogs from each of these three provinces were, therefore, marketed through the single selling agency of the provincial board. Price levels for the U.S. market were represented by the average of eight major hog markets in the U.S. (changed to seven markets beginning in 1970 due to the closing of the Chicago market).[1]

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[1] The seven markets are: St. Louis, Kansas City, Omaha, Sioux City, St. Joseph, St. Paul, and Indianapolis.

SOURCES OF DATA

The major kinds of data collected for this study were weekly average slaughter prices and slaughter numbers. Information on prices and slaughter numbers for all four markets is reported by Agriculture Canada in the weekly publication, Canada Livestock and Meat Trade Report. For the Canadian markets, the prices for dressed weight Grade A (Prior to 1969) or Index 100 hogs, were used.[1] The U.S. seven market average price, as referred to previously, for barrows and gilts was used in this study. U.S. price data needed some adjustment to represent equivalent Canadian prices. U.S. hog prices apply to live weight hogs, whereas, Canadian hog prices apply to the dressed weight. Therefore, the U.S. prices were divided by a factor of .7956,[2] to give the Canadian dressed weight equivalent. Adjustments were also made for exchange rate differences between the Canadian and U.S. currencies.[3] Exchange rate data were obtained from the Bank of Canada Review.

Data for weekly prices and slaughter numbers were collected from January 1, 1961 to December 31, 1980. The time period from January 1, 1961 to October 31, 1969 was taken to represent pre-Board inception, while November 1, 1969 to December 31, 1980 represented the post-Board time period. Time periods which portrayed major policy changes undertaken by the Board were also evaluated.

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[1] The Canadian grading system was changed, effective in 1969.

[2] Adjustment factor provided by Greg Whally, Alberta Pork Producers' Marketing Board, personal communication, Edmonton, July 1980.

[3] Canadian equivalent price was derived as follows: U.S. hog price, divided by .7956, multiplied by exchange rate (U.S. divided by Canadian currency).

ASSESSMENT OF OPERATIONAL AND PRICING EFFICIENCY

One marketing function which was given particular emphasis was the provision of market information, since any improvements in the quality and dissemination of market information should improve both operational and pricing efficiency. A subjective approach was used to evaluate the question of whether there have been improvements in market information since the Board's formation. The factors of the quality and quantity of information, methods of dissemination, and timeliness of information were assessed.

An assessment of secondary data pertaining to marketing costs was used to evaluate the impact of the Board in reducing marketing costs. Marketing costs include the sum of all fees, freight, shrinkage costs, death loss, bruising losses, and insurance costs. A subjective approach was used to evaluate other areas of improved operational efficiency since the Board's formation. Cost savings that accrued through various actions of the Board were assessed. Those operations and functions which were previously fulfilled by government or packing plants and are now performed by the Board were also evaluated.

Graphical analysis was used in the first stage of the analysis to assess pricing efficiency. The objective was to explore the behavior over time of price differentials between the previously mentioned market areas. This analysis provided a historical picture of weekly hog price differentials and illustrated similarities or differences among the markets. Possible policy changes of the Board were linked to major changes in the direction or magnitude of the price differentials. Other economic factors were also used to help explain the changes in the price differentials.

Prices for the four market areas were compared to each other. The price pair differentials were, therefore: Edmonton-Toronto, Edmonton-Winnipeg, Edmonton-U.S., Toronto-Winnipeg, Toronto-U.S., and Winnipeg-U.S. These graphs were made using a computer plotter.

Statistical analysis was also used to evaluate the stability and level of hog prices in different time periods within the four markets. Such analysis was used previously by Veeman and Veeman[1], and by Martin and Warley[2]. The price data were deflated by the consumer price index (1971 = 100) to give real prices in 1971 dollars. The standard deviation, mean values and coefficient of variation about the mean for the various time periods were presented in tabular form.

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[1] M.M. Veeman and T.S. Veeman, op. cit., pp. 36-54.

[2] Larry J. Martin and T.K. Warley, op. cit., pp. 878-884.

THE MODELS USED TO TEST PRICING EFFICIENCY

MODEL 1

This is a model for testing pricing efficiency using correlation coefficients. This model was used to test pricing efficiency and entailed computation of correlation coefficients between the time series of prices for the spatially separated markets. Previously, such a model was used by Lele[1] and Thakur[2]. The model in this study used four market areas and involved arraying the time series of prices as follows:

$$\begin{array}{llll} P_{1j} & P_{1k} & \cdots\cdots\cdots\cdots & P_{1m} \quad \ldots^{1} \\ P_{2j} & P_{2k} & \cdots\cdots\cdots\cdots & P_{2m} \\ \cdot & & & \\ \cdot & & & \\ \cdot & & & \\ \cdot & & & \\ P_{nj} & P_{nk} & \cdots\cdots\cdots\cdots & P_{nm} \end{array}$$

where P_i = weekly average slaughter price of hogs in period i

j to m = location of the market

Correlation coefficients were then calculated for the price series between the different locations. A correlation coefficient of 1 implied perfect unison of the appropriate pair of price series movements, while a coefficeint of zero indicated no relationship.

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[1] Ume J. Lele, op. cit., pp. 267-269.

[2] D.S. Thakur, op. cit., pp. 66-70.

MODEL 2

This model was an econometric model using prices for testing pricing efficiency. In an efficient market, price differences between locations should be equal to transfer costs between markets. A model was used previously in the U.S. by Trierweiler and Hassler[1] to test this hypothesis. The following model was tested in this study:

$$P_{tj} = B_o + B_1 PO_{tk} + U_t \qquad \ldots 2$$

where P_{tj} = weekly average slaughter price of hogs at time t in market j

PO_{tk} = weekly average slaughter price of hogs at time t in market k

U_t = error term

B_o, B_1 = estimated coefficients

On a priori grounds, the estimated B_1 coefficient was expected to be positive. Since PO_{tk} represented the hog price in another market, we would expect that the higher the alternative market price, the higher the original market price.

The values of the coefficients of determination estimated in testing the above equations would indicate perfect unison in price movements if this had a value of 1, while zero would indicate no relationship. It has also been suggested that evidence of an R^2 close to 1 would indicate that there were strong competitive forces in the bidding patterns of the buyers. "Transportation cost differences per hundred weight are represented by the values of the constant terms."[1]

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[1] J.E. Trierweiler and J.B. Hassler, op. cit., pp. 15-16.

MODEL 3

This is a model involving first differences in a price series for the testing of pricing efficiency. Tomek used a first difference equation to analyze the pricing behavior of a declining terminal market in the U.S.[2] In this present study the following model was used to analyze the pricing behavior of the Alberta hog market in different time periods:

$$(P_{tj} - P_{t-1j}) = B_o + B_1 (PO_{tk} - PO_{t-1k}) + U_t \quad \ldots 3$$

where P_{tj} = weekly average slaughter price of hogs at time t in market j

PO_{tk} = weekly average slaughter price of hogs at time t in market k

U_t = error term

B_o, B_1 = estimated coefficients

In the first difference equation, the intercept coefficient provides a measure of average price change for regional differences from week to week in different time periods.[3] The R^2 can again be used to measure the relationship between markets during various time periods. The estimated B_1 coefficient was expected to be positive because as the first difference in price increases in the alternative market, the first difference in the original market would be expected to increase.

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[1] Ibid., p. 16.

[2] William G. Tomek, op. cit., 1980, pp. 438-441.

[3] Ibid., p. 440.

MODEL 4

This model includes supply variables to test pricing efficiency. Previous work by Ikerd[1] and the Canadian Pork Council[2] identified the production-consumption balance of a region as an important factor in determining regional hog price differentials. These previous models used yearly data which would limit the number of observations and degrees of freedom. The model for this study used weekly data with the inclusion of slaughter numbers rather than the production-consumption balance. Dummy variables were also used to account for the surplus or deficit position of pork for the markets under study. The model was constructed as follows:

$$(P_{tj} - P_{tk}) = B_o + B_1 S_{tj} + B2\, S_{tk} + B3\, D_j + B4\, D_k + U_t \quad \ldots 4$$

where P_{tj} = weekly average slaughter price of hogs at time t in market j

P_{tk} = weekly average slaughter price of hogs at time t in market k

S_{tj} = weekly average slaughter numbers for hogs at time t in market j

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[1] John Ikerd, op. cit., pp. 5-25.

[2] Canadian Pork Council, op. cit., pp. 6.1 - 6.47.

S_{tk} = weekly average slaughter numbers for hogs at time t in market k

D_j = a dummy variable to represent the surplus or deficit position of market j

D_k = a dummy variable to represent the surplus or deficit position of market k

U_t = error term

B_0, B_1, B_2, B_3, B_4 = estimated coefficients

The estimated B_1 coefficient was expected to be negative and the B_2 coefficient was expected to be positive. Since S_{tj} represented the supply of hogs in the original market, one would expect that the higher the slaughter numbers, the higher would be the price differential.

If the coefficient of determination in this equation was equal to 1, this would imply that the price differences between markets would be explained by the supply conditions of those markets. If the R^2 was zero, this would indicate no relationship between supply and price differences. Improved pricing efficiency could be inferred if the R^2 was closer to 1 during particular time periods.

CHAPTER VI

AN ASSESSMENT OF MARKET INFORMATION, PROMOTION, OPERATIONAL EFFICIENCY, AND PRICING EFFICIENCY

INTRODUCTION

In this chapter, the assessment which was made of the Board's contribution to improvements in the marketing of hogs is presented. Attention was given in the assessment to market information, promotion, operational efficiency and pricing efficiency.

ASSESSMENT OF MARKET INFORMATION

Prior to the inception of the Board, the main source of market information for producers was government reports, stockyards, packers, truckers, newspapers, and radio.[1] This market information was often inaccurate, misleading, delayed, and lacked uniform distribution among producers. Market information on current market conditions was limited to activities on the terminal markets, which represented only about 5 percent of the hogs marketed in Alberta. Price information was not disseminated by other market agents who accounted for the majority of hogs sold. Forcasts provided by the Federal Government were limited to the percentage change in farrowing and expected hog marketings. Hog price forecasting, which could be more usable and clearly understood by hog producers, was not available before the formation of the Board.[1] However, the Alberta Government provided this price forecasting information after the Board's formation.

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[1] Interview with Lloyd Unterschultz, Alberta Pork Producers' Marketing Board, Edmonton, 18 August 1980.

After the Board's formation, it adopted the

> ... philosophy and practice that producers are entitled to at least as much information about continental markets as processors have available... To insure availability of current information, the Board maintains a small library and subscribes to relevant farm and business publications, market information services and the Livestock Market wire service direct from the U.S. via teletype.[2]

A major source of current market information provided by the Board is the daily code-a-phone service (which was started in June 1978). This is a toll free system, allowing producers, assemblers, truckers and other interested parties in Alberta the opportunity to obtain current market information concerning prices and slaughter numbers in Alberta. Price information from Manitoba, Ontario, and the U.S. is also summarized.

Market information, in the form of a weekly newsletter, is distributed by the Board and gives daily prices and volumes of the major hog markets in Canada and the United

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[1] W. James Lockhart, op. cit., pp. 59-60. See also Paul A. Jenson, op. cit., pp. 56-60.

[2] Harry Little, "Communications Activities of the Alberta Pork Producers' Marketing Board," paper presented to the Hog Marketing Review Committee, Edmonton, 23 June 1980, p. 4. (Mimeographed.)

States for the previous week. This newsletter, which also gives marketing advice and indicates recent market developments, is distributed to Alberta hog producers upon request or on a regular basis with their checks.[1]

The Western Hog Journal[2], which commenced quarterly publication in 1972, provides some information on hog market outlook and forcasts. This magazine is now sent to producers in the prairie provinces and British Columbia. It includes regular summaries of retail and wholesale pork prices in an attempt to supplement producers' understanding of price relationships between provinces and levels of marketing. Included are also "editorial comments on current developments, veterinary reports, hog feeding and management advice, details of various hog industry events, pork promotion activities, pork cookery, and feature sections for each province's events."[3]

In each of the nine districts of the Board in Alberta, there is a director and five delegates. These should provide an atmosphere for a strong communications network. The Board sends each director and delegate regular hog market information and general agricultural development data. A producer can keep close contact with his director or delegate concerning needed information to assist him in making business decisions.[1]

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[1] Interview with Lloyd Unterschultz, op. cit., 18 August 1980.

[2] Previous to 1979 this publication was known as the Alberta Hog Journal.

[3] Harry Little, op. cit., pp. 4-6.

Since the inception of the Board, the quantity and quality of hog market information seems to have increased substantially. The information also tends to be much more current and more evenly distributed among producers. Although producers may not use this market information adequately, they now have access to current and fairly accurate market information to assist them in making management decisions. A central selling agency, such as the Board, has provided the organizational structure to develop some of these improvements in market information. Many developments might not have occurred otherwise.

PORK PROMOTION AND ADVERTIZING

The Board is also involved in providing consumer market information through public relations and advertising. Media advertising, an activity limited by available funds, is used once or twice a year. The Board's cooperative behavior with the pork retail trade is another important means of reaching consumers. "Since establishment of the Board in 1969, more than three million pork recipe brochures have been distributed both through retailer and by direct mail requests, following coupon ads in print media."[2] Additionally, the Board promotes pork products through retailers, trade exhibits and hotel and restaurant industries. In 1980 a new development in promotion, a concentrated media campaign, was implemented with the cooperation of the Board, five processors, and Alberta Agriculture. With the theme "Put Some Pork on Your Fork," the campaign attempted to provide good exposure for both fresh pork and some branded lines produced and sold by cooperating processors.[1]

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[1] Ibid., p. 7.

[2] Ibid., p. 7.

AN ASSESSMENT OF OPERATIONAL EFFICIENCY

Various actions and policy changes of the Board have attempted to reduce marketing costs associated with different sectors of the pork industry. An assessment of the operational efficiencies resulting from these policy changes is outlined in the following section.

PRODUCERS' HOG INDEMNITY FUND

In 1973, the Producers' Hog Indemnity Fund was started by the Board replacing the transit insurance coverage on slaughter hogs previously provided by private insurance companies. Approximately 90 percent of Alberta hog producers subscribe to this Fund and are covered for the loss sustained based upon the fair market value of hogs. Producers' hogs are insured "during the period commencing with the loading of healthy hogs upon a transporting vehicle at the producer's yard and terminating with the hogs becoming the legal property of the purchaser."[1] Reduction in the costs of administration and decrease in the incidence of hog losses were the major objectives in establishment of this Fund. Previous studies have indicated that hog losses did not increase as the length of transportation increased; therefore, the "Fund uses a single rate approach and surcharges those producers who consistently have loss ratios which are far above the norm."[2] Table 6.1 illustrates the cost savings:

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[1] *Ibid*., p. 8.

TABLE 6-1

Commercial Insurance Costs Compared to the Producers' Hog Indemnity Fund Insurance Costs (June 1980)

	Cost in Dollars Per Hog	
Locations	Commercial Insurance	Producers' Hog Indemnity Fund
Barrhead to Edmonton	.32	.19
Lethbridge to Red Deer	.61	.19
LaCrete to Edmonton	1.00	.19
Medicine Hat to Edmonton	.86	.19
Calgary to Red Deer	.32	.19

Source: Gary MacMillan, "Outline of Operations and Financial Aspects of the Alberta Pork Producers' Marketing Board," paper presented to the Hog Marketing Review Committee, Edmonton, 23 June 1980, p. 10. (Mimeographed.)

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[1] M.H. Hawkins, et al., op. cit., 1977, p. 9.

[2] Gary MacMillan, "Outline of Operations and Financial Aspects of the Alberta Pork Producers' Marketing Board," paper presented to the Hog Marketing Review Committee, Edmonton, 23 June 1980, p. 10. (Mimeographed.)

This program involves an ongoing hog death loss prevention progarm. The level of hog losses has averaged 1.74 per thousand head per year since 1974, which is very favorable when compared with other areas.[1] Ontario has had a loss ratio averaging 1.13 per thousand head per year from 1975-1979 and Saskatchewan has averaged losses of 3.36 per thousand head during 1978 and 1979.[2]

ASSEMBLY YARD SYSTEM AND MARKETING COSTS

Prior to the inception of the Board, Manning indicated that "probably the greatest need for cost reduction is in the area of hog assembly."[3] There appeared to be excessive duplication of hog assembly facilities and it would have been more desirable to have hogs assembled at central locations and shipped directly to slaughtering plants.[4]

> ...In 1968, Alberta had over 300 hog assembly locations with more than 500 assemblers,.. Taking all the locations into account, there were 114 that assembled less than 500 hogs and only 67 that assembled more than 5,000 hogs. With more than one assembler at some of these locations, it can be concluded that little specialization existed in the assembly process.[5]

In 1975, the Board began operating marketing yard terminals at six locations in Alberta. The purpose of this system was to provide a more orderly flow of hogs into the market and thereby: "1) reduce wide daily fluctuations in hog prices to stabilize producer returns; 2) maximize packer competition to improve the producers' gross revenue; 3) reduce total marketing costs and reduce the average time involved in moving hogs from the farm to the buyer."[1] Presently, the Board owns five assembly yards, which are located in Lethbridge, Calgary, Red Deer, Edmonton and Grand Prairie. These assembly yards are used to accumulate hogs for out-of-province purchasers, to transport hogs to other areas in Alberta, and to stabilize the flow of hogs during disruptions in the market.

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[1] *Ibid*., p. 11.

[2] Information provided by Lil Holoway, Alberta Pork Producers' Marketing Board, Edmonton, 27 February 1981. (Mimeographed.)

[3] Travis W. Manning, *op. cit*., p. 16.

[4] *Ibid*., p. 15.

[5] James L. Dawson, et al., *op. cit*., p. 7.

Presently, the Board estimates that there are approximately 250 truckers and assemblers in Alberta. Most of these are truckers[2] which would indicate that much of the duplication of hog assembly facilities have been eliminated. Economies of size and assembly yards adapted for handling hogs existing in the Board's assembly yard system have also helped reduce assembly costs, as discussed in the following paragraph.

Marketing and transportation costs for hogs in Alberta have varied somewhat during the past 10 years (Table 6-2).

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[1] Alberta Pork Producers' Marketing Board, Fifth Annual Report, Edmonton, 31 December 1974, p. 3.

[2] Telephone Interview with Lloyd Unterschultz, op. cit., 20 March 1981.

In 1979, over 620,000 hogs, or almost one half of the hogs sold in Alberta, were assembled at the Board assembly yards, with an average cost of fifty five cents per head. These costs have been reducing over time, with further reductions expected.[1] When expressed in 1971 dollars, assembly costs have decreased from 45 cents to 29 cents per hog, from 1970 to 1979. This is a direct saving resulting primarily from the Board's assembly yards system. The combination of transportation costs and marketing costs are harder to evaluate because of the lack of data. However, some cost and return data has been maintained by Alberta Agriculture for specific districts in Alberta. Table 6-2 illustrates, in 1971 dollars, that marketing and transportation costs have been lower in areas such as Lacombe and Edmonton in more recent years when compared to the provincial average for 1970. However, areas such as Taber, Peace River, and High River, which are further away from packing plants, have had higher marketing and transportation costs when compared to the Alberta average for 1970. For hog production units which are further away from packing plants, most of the marketing costs involve transportation costs. The Board has no control over transportation cost except through their assembly yard system and it has been shown that assembly costs have been reduced to a certain degree through Board action.

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[1] Gary MacMillan, op. cit., pp. 7-8.

TABLE 6-2

Marketing and Transportation Costs For Hogs in Alberta

Area	Date	Assembly Costs		Transportation Costs		Total Marketing and Transportation Costs	
		Nominal	Real[1]	Nominal	Real[1]	Nominal	Real[1]
Alberta Average	1970	$0.44	$0.45	$0.96	$0.99	$1.40	$1.44
Edmonton District	1973					$0.30	$0.27
High River District	1974					$1.65	$1.32
Lacombe District	March 1976					$1.45	$0.99
High River District	August 1978					$4.08	$2.29
Peace River District	1979					$3.40	$1.78
Alberta Average for Board Assembly Yards	1979	$0.55	$0.29				
Taber District	January 1981					$4.68	$2.10

[1] Nominal numbers were deflated by the Consumer Price Index, 1971 = 100.

Sources: Alberta average for 1970 obtained from: James L. Dawson, Allan A. Warrack, and Murray H. Hawkins, Locational Analysis for Alberta Hog Assembly Centers, Agricultural Economics and Rural Sociology Bulletin 11 (Edmonton: University of Alberta, 1971), p. 2; Alberta Average for Board Assembly Yards in 1979, obtained from: Gary MacMillan "Outline of Operations and Financial Aspects of the Alberta Pork Producers' Marketing Board," paper presented to the Hog Marketing Review Committee, Edmonton, 23 June 1980, p. 7. (Mimeographed.); All other data obtained from: Alberta Agriculture, A Concensus of Costs and Returns, Production Economics Branch, Edmonton, January 1973, January 1974, March 1976, August 1978, April 1979, and January 1981.

MARKETING LEVIES

Marketing levies charged to producers by the Board to cover the costs of Board services have varied during the past 10 years (Table 6-3). In 1981, the marketing levy was increased by 2 dollars per hog to retire the debt associated with the purchase and start-up costs of the producer owned packing plant. When expressed in terms of 1971 dollars, the other levies have varied from a low of 27 cents per hog in 1973 to a high of 67 cents per hog in 1976. The levy has increased during the past six years, as have the services offered by the Board. It is argued later, in this section, that these levies would probably be higher if the Board had not implemented the computerized data system and "check float" mechanism, along with other efficiencies.

SALES DEPARTMENT OF THE BOARD

The sales department of the Board is responsible for efficient allocation of hogs to the packing plants. Previous to the Board and the implementation of this allocation system, there were times when Edmonton packers would purchase a large portion of Grande Prairie hogs, and then the Grande Prairie packing plant would have to purchase its requirements in the Edmonton area. Now the packing plants do not bid on a particular lot of hogs, but on a certain number of hogs and those hogs closest to the packing plants are delivered. The Board claims that this type of allocation system has

TABLE 6-3

Marketing Levies Charged to Producers by the Alberta Pork Producers' Marketing Board

Time Period	Levy Per Hog In Dollars		Time Period	Levy Per Hog In Dollars	
	Nominal	Real[1]		Nominal	Real[1]
1970	.30	.31	1976 (to March 31)	.75	.50
1971	.30	.30	1976 (from April 1)	1.00	.67
1972	.30	.29	1977	1.00	.62
1973	.30	.27	1978	1.00	.57
1974	.45	.36	1979	1.00	.52
1975 (to August 4)	.45	.32	1980	1.00	.47
1975 (from August 5)	.75	.54	1981 (first quarter)	3.00	1.35

[1] Nominal numbers were deflated by the Consumer Price Index, 1971 = 100.

Source: Alberta Pork Producers' Marketing Board, Annual Reports, Edmonton, various issues.

resulted in increased operational efficiency through transportation cost savings.[1]

The six staff members of the Board's data processing department are responsible for the programing, operation and maintenance of the computer systems. The computer systems primarily deal with hog settlements to producers and accounting functions.[2] As hogs are sold, the packing plants transfer covering documents (manifests and producer receipts) and grading information (kill tickets) to the Board by a bonded delivery service to avoid postal delay. The next day "five machines decollate, burst, sign, trim, fold, insert and mail the settlements to the producers. Automation provides the quickest and least expensive, as well as the most efficient, means of distributing producer settlements."[3] It may take three to seven days or longer for checks to reach the producers by mail and be deposited in the producers' account. Proceeds of these checks are invested by the Board, in liquid accounts drawing interest, before they are cashed. Income from this "check float mechanism" was a source of revenue to the packing plants before the Board's inception, but it now accrues to the Board.[4]

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[1] Ibid., p. 3.

[2] Ibid., p. 1.

[3] M.H. Hawkins, et al., op. cit., 1977, p. 8.

[4] Interview with Sten Berg, former pork producer and Chairman of the Alberta Pork Producers' Marketing Board from 1971 to 1972, Sherwood Park, Alberta, 19 February 1981.

In 1979, interest accruing to the Board was $466,437, mainly generated through the check float mechanism. This amounts to approximately one-third of the total general operation revenue of $1,493,088, with most of the other two-thirds coming from producer marketing levies.[1] Money generated through the "check float" is used to help cover administrative costs. This is an indirect benefit to the producers because their levies are probably reduced as a result of this additional revenue.

The Board's data processing department also performs various services that were previously performed by government or by packing plants. Hog cost analysis and invoices are prepared by the Board for most of the packing plant industry. Trucking and assembly businesses also receive weekly payments through the Board. Additionally, the Board prepares and submits a great deal of statistical information each week for various branches of the Federal Government, which was previously required from the packing house industry. It is difficult to determine the benefit of these services to the processing plants, since the Board prepares these reports as a free service for the packing plant industry. Jack Hanmer, the former manager of Swift Canadian Co. Ltd., indicated that one government report previously took five full-time employees to prepare. The Board estimates that seventy five percent of the work performed by its data processing department was previously accomplished by the packing plant industry. In addition to the above mentioned reports, the data processing department completes other reports for branches of the Provincial and Federal Governments, the Board of Directors for the Board, and other administrative departments.[1]

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[1] Alberta Pork Producers' Marketing Board, Tenth Annual Report, Edmonton, 31 December 1979, p. 14.

The functions mentioned in the preceding paragraph which are performed by the Board for other sectors of the pork industry are not necessarily a cost savings to the Board. However, economies of scale and technological efficiencies are probably created when the Board performs these tasks rather than each individual packing plant. Therefore, the entire pork industry should benefit.

CARCASS IDENTIFICATION

Carcass identification is necessary to ensure efficient movement of hogs and proper identification and settlement to the producer. Hog carcasses are identified by a tattooing system which is registered with the Board and also registered in Ottawa with Agriculture Canada. A program started in 1973, which is a service performed by the Board for Agriculture Canada; explains the importance and proper methods of tattooing.

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[1] Gary MacMillan, op. cit., pp. 1-2.

> ...If a tattoo has been improperly applied, it is reported to the Board by the Federal hog carcass grader. The Board then contacts the owner of the tattoo machine. This encourages proper tattooing methods being used so that producers may receive proper settlements. Repeated offenders usually enter an educational program or they may also have to personally deliver their hogs to a Board assembly yard.[1]

A SUBJECTIVE ASSESSMENT OF PRICING EFFICIENCY

ALBERTA HOG TRADING COMPANY LTD.

The Alberta Hog Trading Company Ltd. was established in 1978 as a wholly owned subsidiary of the Alberta Pork Producers' Marketing Board. Previous to the formation of the Trading Company, the Board, like other marketing agencies, guaranteed that producers would be paid for hogs they shipped, which resulted in financial losses to the Board at times. Alberta producers are now guaranteed payment by the Livestock Patrons' Assurance Fund, for hogs slaughtered in Alberta. Partly to reduce the financial risk faced by the Board and producers who sell hogs out of the province, the Board created the Alberta Hog Trading Company Ltd.

Under normal circumstances, the Alberta Hog Trading Company Ltd. purchases hogs for customers in the U.S. or other provinces, in direct competition with Alberta packing plants.[1] In 1980, approximately 70,000 hogs were purchased by the Trading Company. Additionally, the Alberta Trading Company Ltd. promotes development of interprovincial and international markets for Alberta hogs and pork by coordinating large orders for pork that can not be filled by one packing plant.[2] Occasionally the Trading Company will also import hogs to Alberta for market related reasons such as the occurrence of market arbitrage. Trading Company sales in 1978 "of more than 50,000 hogs, mostly to the U.S.A., during the eight week packinghouse strike/lockout prevented a backlog of hogs from developing and was thereby responsible for helping...hold hog prices up."[3]

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[1] M.H. Hawkins, et al., op. cit., 1977, p. 9.

DOMESTIC HOG CONTRACTING

In August and September of 1978, domestic hog contracting began with Fletchers and Burns. Under these contracts, hogs were priced on a formula which was based on a combination of current hog prices in major Canadian and U.S. markets. The Board claimed that these domestic contracts should have helped achieve hog prices that were more reflective of outside markets, thereby stimulating producer confidence. Fletcher's president, John Newton, also indicated that domestic contracting should "allow his firm to become more confident in seeking expanded markets on both the domestic and export fronts."[1]

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[1] Gary MacMillan, op. cit., pp. 12-14.

[2] Interview with Rod Buray, Alberta Pork Producers' Marketing Board, Edmonton, 16 March 1981.

[3] Alberta Pork Producers' Marketing Board, Ninth Annual Report, Edmonton, 31 December 1978, p. 4.

FOREIGN EXPORTS

Through forward contracting of hogs, for export, the Board's primary objective is to reduce market uncertainty and risk, allowing hog producers a base for future business decisions.

> ...Forward contracting has reduced the fluctuation between market prices and the major portion of production costs to a known amount. This reduction has been achieved through an ongoing cost and price adjustment which has been calculated using a "flexibility" formula based on the changing cost of feed inputs going into the production program of each producer.[2]

Between January 1974 and 1981, under forward contracting for export, specific cuts from approximately 600,000 hogs were shipped to Japan. During 1979, 450 tons of pork were shipped from western Canada to Korea.[3] These export contracts have been signed by individual producers, packing plants and the Board. "The Board's responsibility is to act as negotiator between buyer and seller with certain supervisory and control responsibilities such as producer bonding and export carcass audit."[1]

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[1] Alberta Hog Journal, op. cit., Fall 1978, p. 5.

[2] M.H. Hawkins, et al., op. cit., 1977, p. 8.

[3] Western Hog Journal, op. cit., various issues.

PRODUCER OWNED PACKING PLANT

In February 1981, the Alberta Pork Producers' Marketing Board purchased and assumed control of Fletcher's Ltd., a pork processing operation. This firm has a kill line in Red Deer and the chilled carcasses are shipped to its Vancouver plant for further processing. The Board has stated that "this arrangement gives Alberta pork producers excellent access to the B.C. market, the Pacific Northwest U.S., and the Pacific rim export market." The major goals stated by the Board for this producer owned plant are to:

> i) ensure that producers are paid hog prices which are reflective of the current market circumstances or in the least, ensure that a portion of the industry's profits are shared by pork producers; ii) implement contemporary processing and marketing techniques such that the pork producer is properly represented in the consumer pork market; iii) ensure that everything possible is done to establish long-term export markets in areas such as the Pacific Northwest U.S., and the offshore markets.[2]

The Board is using vertical integration to countervail oligopoly pricing power. With ownership of a packing plant the Board has set a goal to influence the pricing structure of Alberta hogs, which may be difficult to attain. However, there are certain benefits and efficiencies which could result from vertical integration. This producer owned plant can be assured of hog supplies and the producers can be assured of at least one market for their hogs during disruptions in the marketplace, such as labor union disputes. Integration permits economies in transferring products from one stage of marketing to another[1] and vertically integrated firm may also have a natural tendency for stability in the market.[2]

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[1] M.H. Hawkins, et al., op. cit., 1977, p. 8.

[2] Western Hog Journal, op. cit., Winter, 1981, p. 22.

SUMMARY OF IMPROVEMENTS

Since the Board's inception, the quantity and quality of hog market information have increased. The market information tends to be more current and more evenly distributed among producers. The Board has also contributed to the increased operational efficiency of marketing hogs in Alberta. Cost savings have been introduced through the Board's establishment of the Producers' Hog Indemnity Fund and assembly yard system. The sales department and data processing department have also shown areas of increased operational efficiency through the hog allocation system,

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[1] F.M. Scherer, op. cit., p. 247.

[2] Richard Caves, op. cit., p. 44.

"check float mechanism", and hog settlement process. Pricing efficiency improvements followed a more subjective assessment. Areas of possible improvements in pricing efficiency were found through the Alberta Hog Trading Company, market information, and domestic and export contracting. Pricing efficiency will be analyzed more thoroughly through empirical evidence in the following chapter. The Board's central selling agency has provided the mechanism and structure to develop these improvements in market information, operational efficiency, and pricing efficiency. Many of these improvements could not have occurred without the Board's existence or the existence of a similar central marketing agency.

CHAPTER VII

RESULTS OF THE EMPIRICAL ANALYSIS

INTRODUCTION

In this chapter, data on prices and slaughter numbers were analyzed using the methods and models described in Chapter V. A graphical illustration of the six price differences between the four markets specified in this study was presented together with correlation coefficients and statistical information on the prices. Models 2 and 3 refer to the relationship of hog prices between the four markets, while Model 4 utilized elements of supply variables and tested their relationship to price differences between various markets.

GRAPHICAL ILLUSTRATION OF PRICE DIFFERENTIALS BETWEEN EDMONTON, WINNIPEG, TORONTO AND THE U.S.

The intermarket price spreads between the four markets considered in this study tended to fluctuate considerably from 1961 to 1980. They also generally appeared to follow a two or four year cycle[1] (Figures 7-1 to Figure 7-6). The

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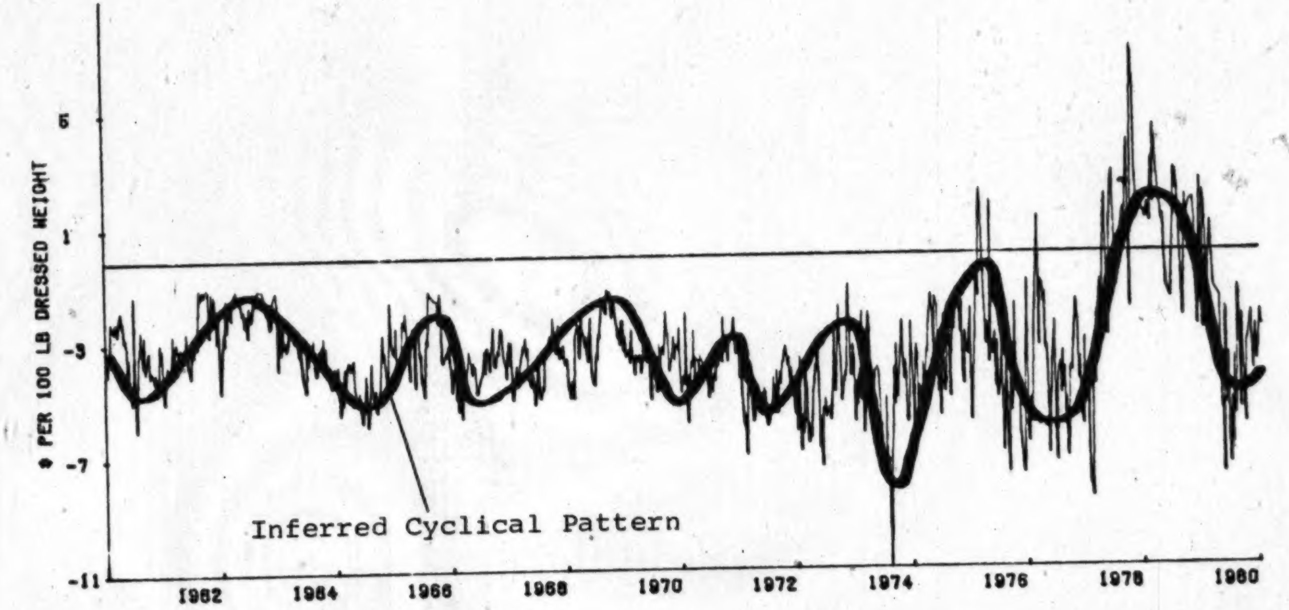
[1] An earlier study by Petrie, for Agriculture Canada, found that the Canada-U.S. price differential appeared to be cyclical in nature from 1954 to 1972.; Source: T.M. Petrie, Seasonal, Cyclical and Trend Variations in the Hog Industry (Ottawa: Agriculture Canada, 1974), p. 33.

FIGURE 7-1

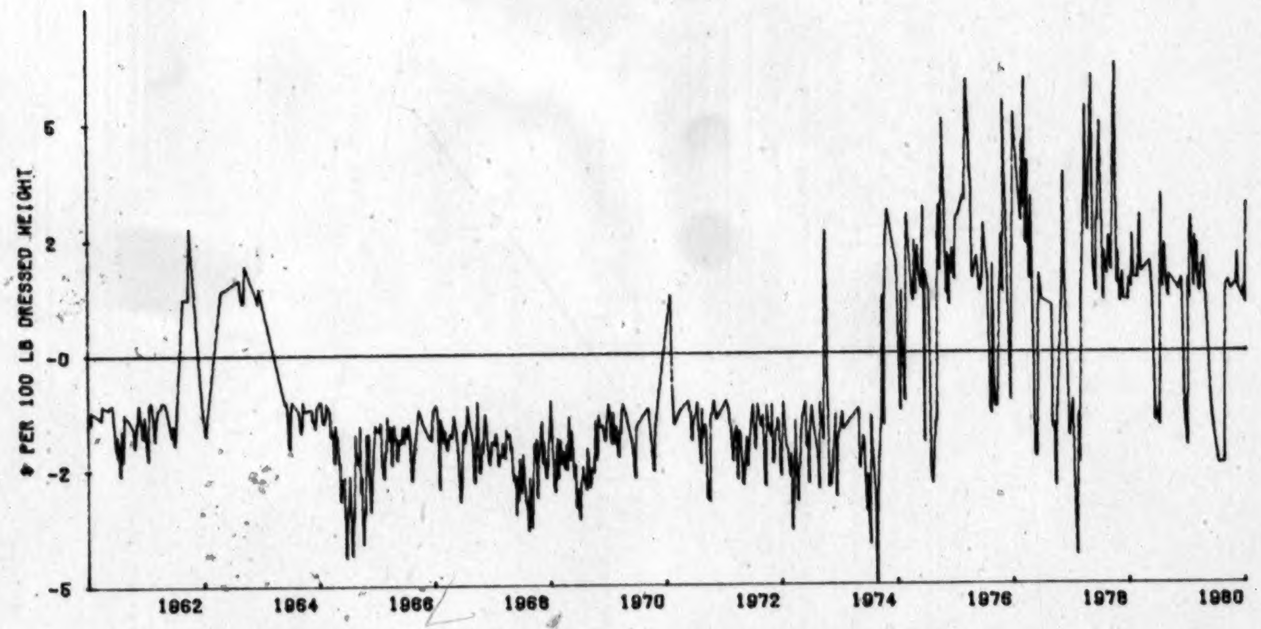
Hog Price Differences for Edmonton Minus Toronto (1961 - 1980)



Source: Graph calculated from data in Agriculture Canada, Marketing Services Division, Canada Livestock and Meat Trade Report (Ottawa: 1961-1980).

FIGURE 7-2

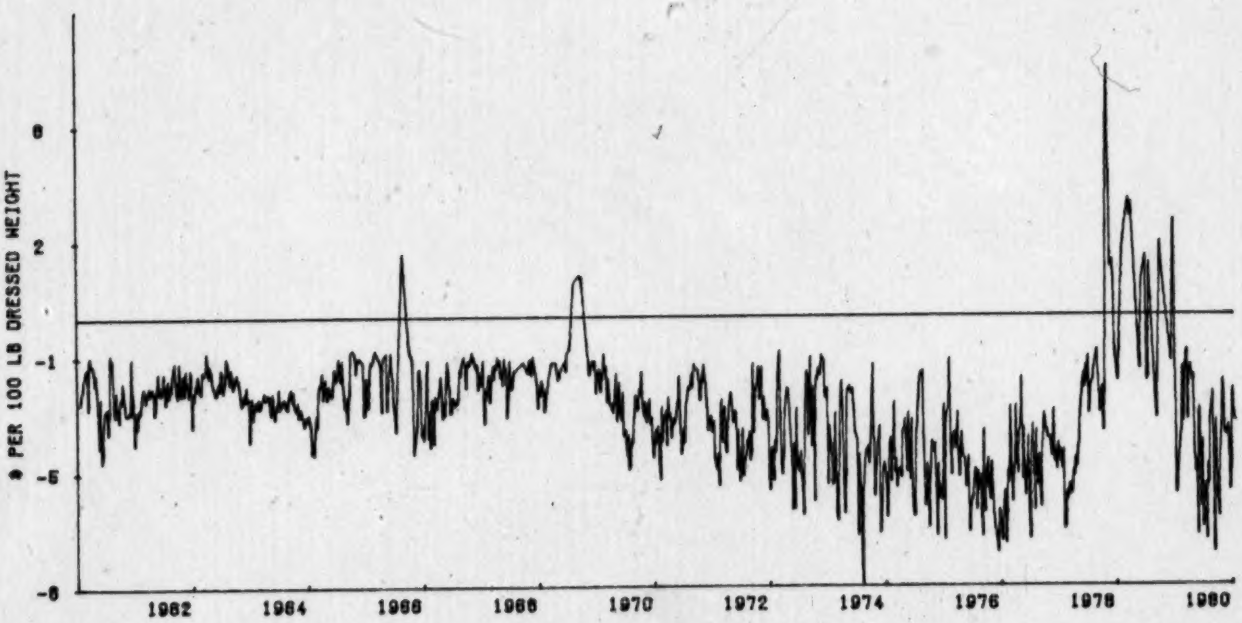
Hog Price Differences for Edmonton Minus Winnipeg (1961 - 1980)



Source: Graph calculated from data in Agriculture Canada, Marketing Services Division, Canada Livestock and Meat Trade Report (Ottawa: 1961-1980).

FIGURE 7-3

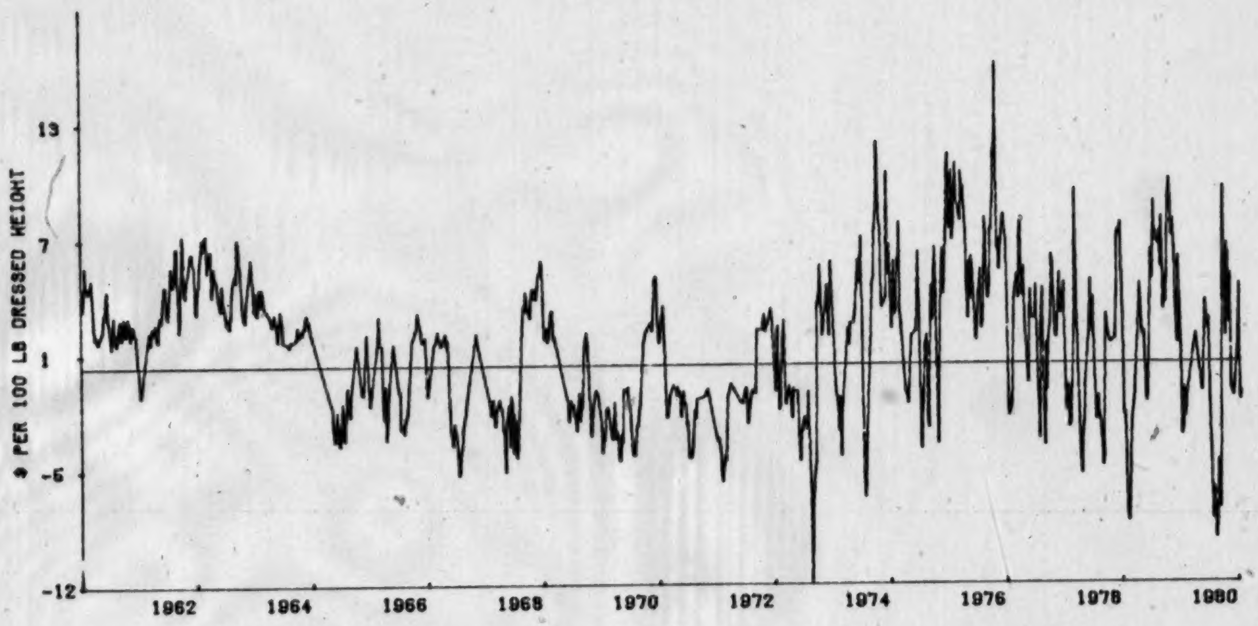
Hog Price Differences For Winnipeg Minus Toronto (1961 - 1980)



Source: Graph calculated from data in Agriculture Canada, Marketing Services Division, Canada Livestock and Meat Trade Report (Ottawa: 1961-1980).

FIGURE 7-4

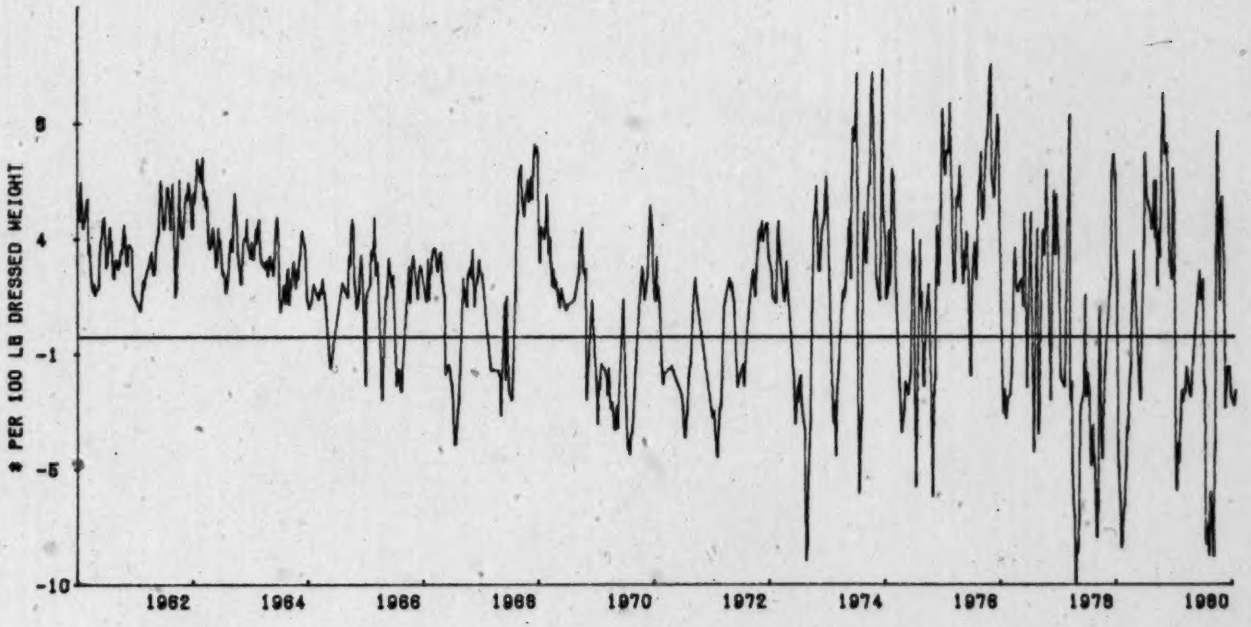
Hog Price Differences For Edmonton Minus the Average For the U.S. 7 Markets, Canadian $ Dressed Weight Equivalent (1961-1980)



Source: Graph calculated from data in Agriculture Canada, Marketing Services Division, Canada Livestock and Meat Trade Report (Ottawa: 1961-1980).

FIGURE 7-5

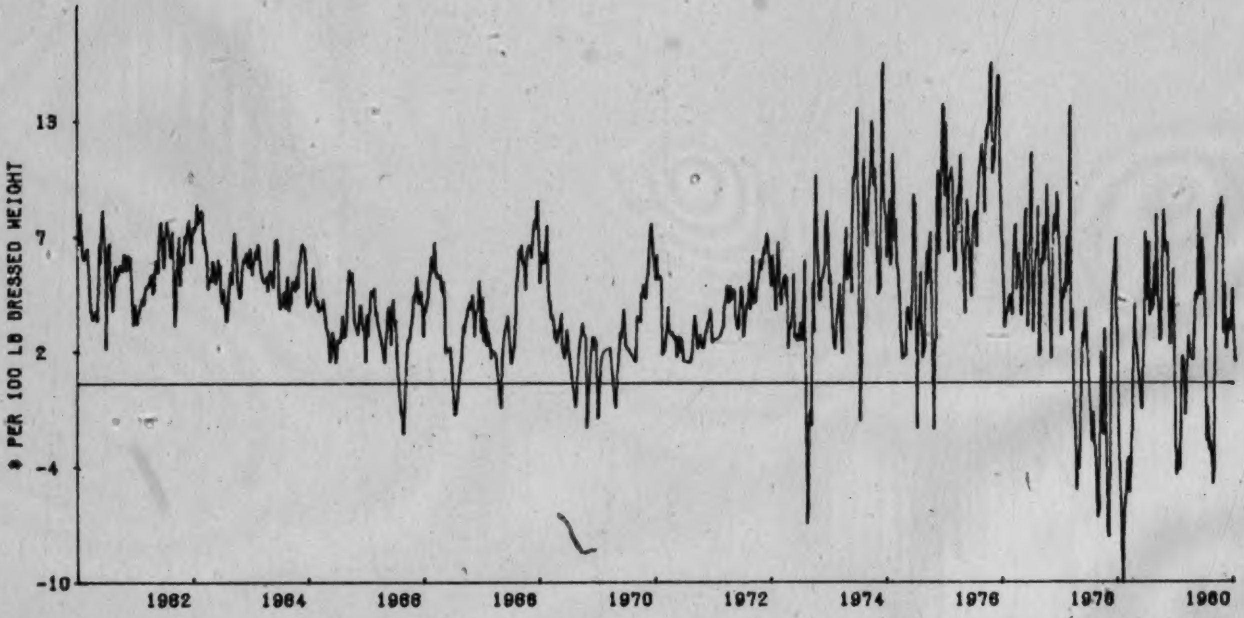
Hog Price Differences For Winnipeg Minus the Average For the U.S. 7 Markets, Canadian $ Dressed Weight Equivalent (1961-1980)



Source: Graph calculated from data in Agriculture Canada, Marketing Services Division, Canada Livestock and Meat Trade Report (Ottawa: 1961-1980).

FIGURE 7-6

Hog Price Differences For Toronto Minus the Average For the U.S. 7 Markets, Canadian $ Dressed Weight Equivalent (1961-1980)



Source: Graph calculated from data in Agriculture Canada, Marketing Services Division, Canada Livestock and Meat Trade Report (Ottawa: 1961-1980).

Edmonton-Toronto price spread declined in 1961 and increased until 1963. It then declined until 1965 when it once again swung upward, and so forth (Figure 7-1). The other five price differences also tend to show some cyclical variation over time (Figures 7-2 to Figure 7-6).

EDMONTON-TORONTO PRICE DIFFERENTIAL

The hog price difference between these two markets fluctuated considerably. The Toronto price approximated between two and six cents per hundredweight higher than the Edmonton hog price until 1975. This pattern then changed with the Edmonton price being higher than the Toronto price for a few weeks at the beginning and end of 1976. For most of 1978 and 1979 the Edmonton price was higher. However, in 1980 the price differential returned to the Toronto price being above the Edmonton price by two to six cents per hundredweight (Figure 7-1).

EDMONTON-WINNIPEG PRICE DIFFERENTIAL

From 1961 to 1974, the Winnipeg price was above the Edmonton price by one to four cents per hundredweight, except for most of 1963 and a few occasional weeks during 1961, 1971 and 1973. A major change occurred in the price differences at the end of 1974. From that period until 1981, most of the observations indicated that the Edmonton price was above the Winnipeg price by one to five cents (Figure 7-2).

WINNIPEG-TORONTO PRICE DIFFERENTIAL

The Winnipeg-Toronto price differential (Figure 7-3) shows a similar general pattern to the Edmonton-Toronto pattern (Figure 7-1). However, there are some differences in these two graphs. The magnitude of the price differences were usually less between Winnipeg and Toronto than were the size of the price differences between the Edmonton and Toronto markets. Between 1978 and 1980, the Edmonton price was higher than the Toronto price for a longer time period than the Winnipeg price was above the Toronto price.

EDMONTON-U.S. PRICE DIFFERENTIAL

The price differential for dressed weight hog prices between Edmonton and the average of the specified seven U.S. markets fluctuated continuously and to a larger degree than did the price differences between the various Canadian markets. The Edmonton prices tended to be above the U.S. average prices from 1961 to the end of 1964. From 1965 onward, these price differentials appeared to follow a pattern of two or three year cycles. One market price was higher, then for one or two years the other market price was higher. There were periodic shifts in price differences throughout these fifteen years. However, from 1965 to 1974 the U.S. price seemed to be higher and from 1975 to 1980 this pattern was reversed as the Edmonton hog price tended to be higher (Figure 7-4).

WINNIPEG-U.S. AND TORONTO-U.S. PRICE DIFFERENCES

The Winnipeg-U.S. and the Toronto-U.S. price differences (Figures 7-5 and 7-6) seemed to follow the same general pattern as the Edmonton-U.S. price differential (Figure 7-4). However, Winnipeg and, in particular, Toronto appeared to have higher prices than the U.S. average price throughout the twenty year period considered (Figures 7-5 and 7-6).

SOME EXPLANATIONS OF THE FLUCTUATIONS AND CYCLES WHICH OCCURRED IN THE PRICE DIFFERENCES

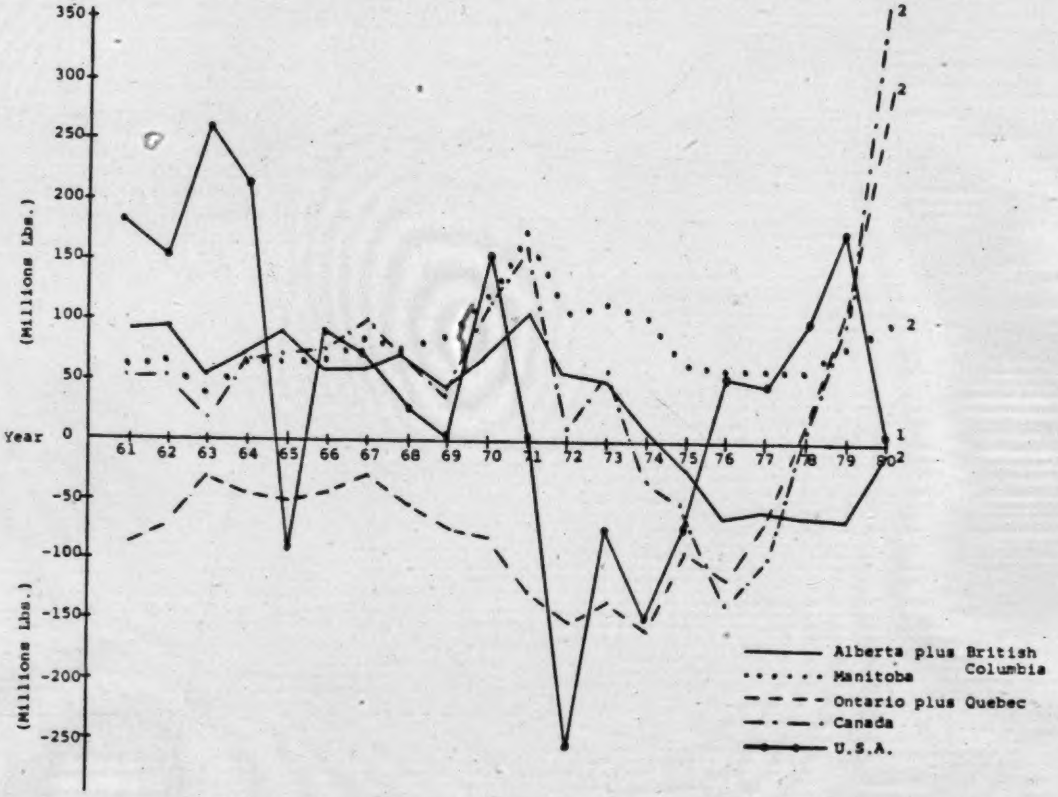
Cycles which occurred in price differentials between market areas were presumably caused by cyclical movements in regional demand and supply conditions. Less regular fluctuations in price differences were likely due to changes in transportation costs, conditions between markets, or institutional practices, as well as regional supply and demand factors. This section will attempt to assess some of these elements and their effects on price differences between markets.

DEMAND AND SUPPLY CONDITIONS

According to economic theory, regional and national demand and supply conditions (Table 7-1 and Figure 7-7) should have an influence on price differences between markets. The supply and demand conditions of the Alberta plus British Columbia region and the Ontario plus Quebec region

FIGURE 7-7

Net Surplus (Deficit) Position of Pork by Region



[1] 1980 Production of pork for Canada are actual figures while Domestic Disappearance are 1979 figures since the 1980 per capita pork consumption was not published at the time this study was completed.

[2] 1980 figures for the U.S. did not include the month of December.

Source: Calculated from data from the following sources: Statistics Canada, Livestock and Animal Products Statistics, Catalogue No. 23-203, 1967, 1975, 1979; Statistics Canada, Estimates of Population for Canada and the Provinces, Catalogue No. 91-201, 1979; Canadian Pork Study, Spatial Price Differences for Hogs in Canada (Ottawa, Ontario: 1979), pp. 6.28-6.27; Agriculture Canada, Food and Agriculture Marketing Branch, Livestock Market Review (Ottawa: 1961-1979). U.S. Department of Agriculture, Economics and Statistics Service, Livestock and Meat Situation, (Washington D.C..: 1961-1980).; Provincial consumption of pork was calculated by multiplying per capita consumption data for Canada by the provincial populations. Factors such as differences in average personal disposable income, tastes, etc., which would result in actual consumption differences were ignored.
Production was calculated by multiplying the average cold trimmed weight of hogs in Canada by the number of hogs slaughtered through federally inspected and uninspected plants in each province. The difference between production and consumption gave the surplus or deficit position of each province. The production and consumption figures for the United States were those given in the above U.S.D.A. publication for each month.

TABLE 7-1

Production, Domestic Disappearance, and Net Surplus (Deficit) Position of Pork by Region (1961-1980)

	British Columbia	Alberta	Sask.	Manitoba	Ontario	Quebec	Atlantic Provinces	Canada	U.S.
	(Millions of Lbs.)								
1961									
1) Production	43	201	90	111	310	186	35	975	10,730
2) Dom. Disappearance	82	70	47	46	314	265	95	918	10,548
3) 1) - 2)	-39	+131	+43	+65	- 4	-78	-60	+56	+182
1962									
1) Production	36	209	81	103	324	198	33	985	11,229
2) Dom. Disappearance	83	69	47	47	318	269	96	929	11,073
3) 1) - 2)	-47	+141	+34	+57	+ 5	-71	-63	+56	+156
1963									
1) Production	29	179	64	90	370	213	35	981	11,863
2) Dom. Disappearance	86	71	47	48	329	278	99	958	11,597
3) 1) - 2)	-56	+108	+16	+42	+41	-65	-63	+23	+266
1964									
1) Production	27	207	80	111	389	208	37	1,060	12,006
2) Dom. Disappearance	90	74	49	50	343	289	101	997	11,784
3) 1) - 2)	-63	+133	+32	+61	+45	-81	-64	+63	+222
1965									
1) Production	31	209	75	107	352	194	38	1,007	10,736
2) Dom. Disappearance	86	69	46	46	325	272	94	939	10,830
3) 1) - 2)	-55	+140	+29	+61	+27	-78	-57	+ 67	-94
1966									
1) Production	29	186	79	109	373	195	44	1,015	11,135
2) Dom. Disappearance	88	69	45	45	327	272	93	938	11,039
3) 1) - 2)	-59	+117	+34	+64	+46	-76	-49	+77	+96
1967									
1) Production	35	209	93	134	430	248	47	1,195	12,375
2) Dom. Disappearance	105	80	51	52	383	315	107	1,094	12,300
3) 1) - 2)	-70	+129	+42	+82	+46	-68	-60	+101	+75
1968									
1) Production	34	230	86	129	407	240	49	1,176	12,877
2) Dom. Disappearance	107	82	52	52	389	318	108	1,107	12,848
3) 1) - 2)	-74	+149	+35	+78	+18	-78	-58	+69	+29
1969									
1) Production	34	193	91	130	395	229	49	1,122	12,783
2) Dom. Disappearance	106	80	50	50	380	308	104	1,078	12,782
3) 1) - 2)	-72	+113	+41	+80	+16	-78	-55	+45	+1
1970									
1) Production	35	241	132	182	455	259	58	1,362	13,246
2) Dom. Disappearance	125	94	55	58	443	353	120	1,247	13,091
3) 1) - 2)	-90	+148	+77	+124	+12	-93	-62	+115	+155
1971									
1) Production	39	312	163	223	481	279	60	1,557	14,606
2) Dom. Disappearance	142	106	60	64	501	392	134	1,398	14,605
3) 1) - 2)	-103	+206	+103	+159	-20	-113	-73	+159	+1
1972									
1) Production	27	278	158	175	441	266	49	1,393	13,455
2) Dom. Disappearance	141	105	58	66	493	382	131	1,375	13,711
3) 1) - 2)	-114	+174	+100	+109	- 52	-116	-82	+18	-256
1973									
1) Production	23	268	154	176	421	270	49	1,360	12,579
2) Dom. Disappearance	137	100	54	59	469	360	125	1,304	12,650
3) 1) - 2)	-114	+168	+100	+117	-48	-91	-76	+56	-71
1974									
1) Production	22	243	149	167	420	299	47	1,374	13,588
2) Dom. Disappearance	148	107	56	63	500	380	132	1,385	13,742
3) 1) - 2)	-126	+136	+94	+105	-80	-81	-85	-38	-156
1975									
1) Production	20	181	97	121	376	310	44	1,148	11,305
2) Dom. Disappearance	130	95	48	54	436	329	115	1,206	11,376
3) 1) - 2)	-110	+86	+49	+67	-60	-19	-71	-58	-71
1976									
1) Production	16	165	91	114	376	326	42	1,129	12,220
2) Dom. Disappearance	136	102	51	56	457	345	121	1,268	12,168
3) 1) - 2)	-120	+63	+40	+57	-81	-20	-79	-139	+52
1977									
1) Production	20	172	88	116	379	370	43	1,188	13,051
2) Dom. Disappearance	138	105	52	57	464	348	122	1,287	13,004
3) 1) - 2)	-119	+67	+36	+59	-85	+21	-79	-99	+47
1978									
1) Production	26	179	101	116	437	456	51	1,366	13,209
2) Dom. Disappearance	146	113	55	60	488	363	129	1,354	13,109
3) 1) - 2)	-120	+66	+46	+57	-51	+93	-77	+12	+100
1979									
1) Production	31	214	101	147	529	573	58	1,653	15,290
2) Dom. Disappearance	168	132	63	67	557	413	147	1,546	15,103
3) 1) - 2)	-137	+82	+38	+79	-28	+160	-89	+107	+187
1980									
1) Production[1]	49	243	121	168	627	668	11	1,946	14,995[2]
2) Dom. Disappearance	168	132	63	67	557	413	147	1,546	14,992
3) 1) - 2)	-119	+112	+58	+100	+70	+255	-136	+400	+3

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[1] 1980 Production of pork for Canada are actual figures while Domestic Disappearance are 1979 figures since the 1980 per capita pork consumption was not published at the time this study was completed.

[2] 1980 figures for the U.S. do not include the month of December.

Source: Calculated from data from the following sources: Statistics Canada, Livestock and Animal Products Statistics, Catalogue No. 23-203, 1967, 1975, 1979; Statistics Canada, Estimates of Population for Canada and the Provinces, Catalogue No. 91-201, 1979; Canadian Pork Study, Spatial Price Differences for Hogs in Canada (Ottawa, Ontario: 1979), pp. 6.28-6.47; Agriculture Canada, Food and Agriculture Marketing Branch, Livestock Market Review (Ottawa: 1961-1979). U.S. Department of Agriculture, Economics and Statistics Service, Livestock and Meat Situation (Washington D C..: 1961-1980).,

Provincial consumption of pork was calculated by multiplying per capita consumption data for Canada by the provincial populations. Factors such as differences in average personal disposable income, tastes, etc., which would result in actual consumption differences were ignored.

Production was calculated by multiplying the average cold trimmed weight of hogs in Canada by the number of hogs slaughtered through federally inspected and uninspected plants in each province. The difference between production and consumption gave the surplus or deficit position of each province. The production and consumption figures for the United States were those given in the above U.S.D.A. publication for each month.

(Figure 7-7) may explain some of the fluctuations in the Edmonton-Toronto price differences (Figure 7-1). Prior to 1975, the Alberta plus British Columbia region was in a pork surplus position and the Ontario plus Quebec region was in a deficit pork position. During this period of time the Toronto price for hogs was above the Edmonton price, as would be expected, even though the level of price difference may have been excessive.[1] In 1975, both the Alberta plus British Columbia region and the Ontario plus Quebec region were in a deficit pork supply-consumption position. The hog price differences between these two markets might be expected to be closer with about the same level of supply and demand inbalance for both markets. However, for only a few weeks between 1976 to 1978 was this the case. As the Ontario and Quebec region gained a surplus in pork in 1978, as would be expected, the Edmonton hog price became higher than the Toronto price by one to four cents per hundredweight, until the beginning of 1980. During most of 1980, this pattern was reversed with the Toronto price being higher than the Edmonton price even though there was no apparent change in the surplus or deficit position of these two regions. Possible reasons for this shift in price differences and for other price shifts will be discussed later in this chapter.

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[1] Economic theory suggests that under perfect competition (assuming perfect knowledge, homogeneous commodities, and no time lags) the price difference between a surplus region and a deficit region should generally be equal to or less than transfer costs between those two markets if arbitrage occurs.

The Winnipeg-Toronto price difference for hogs tended to follow the same general pattern as did the Edmonton-Toronto price difference. Therefore, the Winnipeg-Toronto price difference (Figure 7-3) can be explained in much the same manner as for the Edmonton-Toronto price difference. Some fluctuations in the Edmonton-Winnipeg price difference may be explained by the regional trade balances. When the Alberta plus British Columbia and Manitoba regions both had surpluses in pork prior to 1974 (Figure 7-7), Winnipeg's hog price was generally one to four cents higher than the Edmonton hog price (Figure 7-2). As the Alberta and British Columbia region became deficient in pork in 1975, the Edmonton hog price was generally higher than the Winnipeg price by one to five cents per hundredweight even though short-run fluctuations and reversals in price differences occurred.

There seems to be less relationship between the surplus or deficit position of pork in the U.S. and the difference in price between the U.S. and Canadian markets. This is illustrated when Figure 7-7 is compared with Figures 7-4, 7-5, and 7-6. When the U.S. became deficient in pork in 1965, the hog prices seemed to be higher in the U.S. market. As the U.S. became deficient in pork again from 1971 to 1975 the Canadian price only seemed to strengthen after about a two year lag. It is interesting to note that the trade balance between Canada and the U.S. (Table 2-1) corresponds more directly to the Canadian than the U.S. supply and demand conditions (Figure 7-7). Supply and demand conditions undoubtedly had a role in establishing price differences between the market areas considered in this study. However, the wide and fluctuating shifts in price differences between markets and their lack of relationship to national demand and supply conditions (Figures 7-1 to 7-6) suggests that demand and supply conditions were not the only factors affecting price spreads between markets. It seems that regional demand and supply conditions had a much greater impact on price differences than the national U.S. or Canadian demand and supply conditions. One of the reasons for this apparent segmentation of the market (which would be expected) will be discussed in the following section.

INFORMAL PROCUREMENT ARRANGEMENTS

Another explanation of some of the price behavior between markets may be the procurement arrangement between processors and retailers in western Canada.

> It is alleged that Canada Safeway which controls 50-60 percent of Alberta's retail sales volume has developed a program with intercontinental Packers at Saskatoon for processed packaged cooked meat and pork supplies under private Safeway label. Currently such products are marketed in

> Alberta and Saskatchewan. Fletcher's Ltd. have undertaken similar arrangements for Safeway in B.C.[1]

These types of informal contracts, involving such a large volume retailer in Alberta and B.C. tend to establish fairly even weekly flows of pork within the market. This seems to segment the market so that the regional supply and demand conditions dominate rather than the American or Canadian supply and demand conditions. This is illustrated by comparing supply and demand conditions (Figure 7-7) with the price differences between markets (Figures 7-1 to 7-6).

TRANSFER COSTS BETWEEN MARKETS

Economic theory suggests that under perfect competition (assuming perfect knowledge, homogeneous commodities, and no time lags) the price differences for a homogeneous product between different markets should be less than or equal to transfer costs between those markets. This theory assumes arbitrage can occur if price differences between markets are greater than transfer costs and assuming that trade occurs between these markets. However, critics have argued that the situation for pork in Canada may not follow this pattern (Figure 7-8). Price differentials between the mid-

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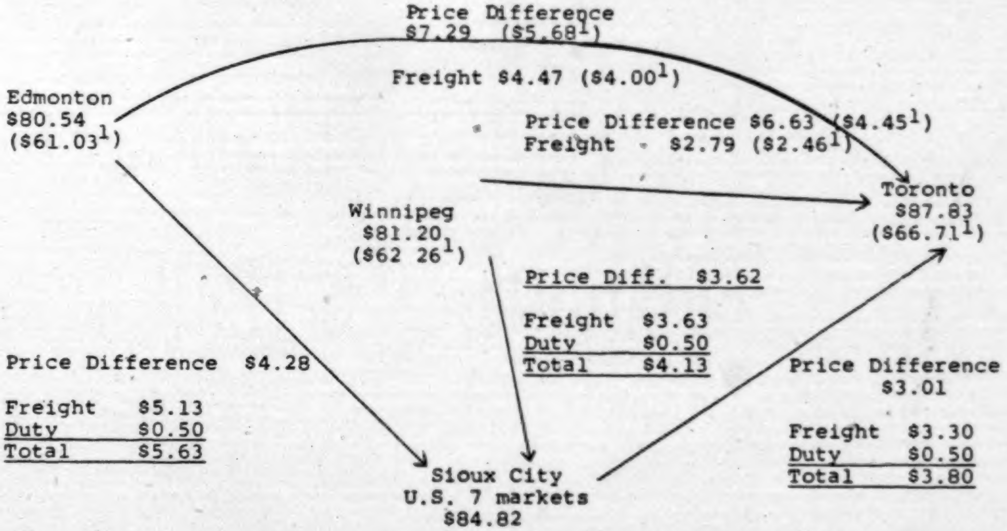
[1] Murray H. Hawkins and Reginald R. Norby, "The Implications of Vertical Integration by Food Retailers on the Canadian Pork Marketing System," Occasional paper No. 2, Edmonton, University of Alberta, November 1977, pp. 17 and 18.

FIGURE 7-8

Partial Price Differences For Pork in Canada and the U.S. Midwest (January and February Average, 1978; and April 1977)

Market (1)	Hog Price Index 100 Dressed Weight (2)		Less Cutting Shrink (2) ÷ 0.97 (3)		Less Larding Fat and Cutting Shrink (3) ÷ 0.83 (4)	
	April 1977	Jan. & Feb. 1978	April 1977	Jan. & Feb. 1978	April 1977	Jan. & Feb. 1978
	---------- Canadian $ Per Hundred Weight ------------					
Edmonton	49.13	64.84	50.65	66.85	61.03	80.54
Winnipeg	50.31	65.38	51.68	67.40	62.26	81.20
Toronto	53.71	70.71	55.37	72.90	66.71	87.83
U.S. 7 markets		68.29		70.40		84.82



[1] Numbers in brackets represent April 1977 data while all the other data represent January and February 1978 averages.

[2] Unfortunately freight rates given in a time series between hog markets was not readily available.

Source: Data for January and February 1978 from Canadian Pork Council, Spatial Price Differences For Hogs in Canada (Ottawa, Ontario: March, 1979) p. 5.6.; Data for April 1977 from Agriculture Canada, Food Systems Branch, The Canadian Pork Industry (Ottawa: August 1977), pp. 86-87 and Agriculture Canada, Food Production and Marketing Branch, Livestock Market Review (Ottawa: 1977).

west U.S. and the Canadian markets, in part of 1978, seemed to be appropriate in that they represented transportation and tariff costs. However, the price differentials between the Canadian markets seemed much out of line when they were compared to transportation costs during part of 1977 and 1978. The price differences for these two time periods seem fairly representative of price differences from 1961 to 1978. The five year Toronto-Edmonton average price difference, from 1973 to 1977 inclusive, was $4.04 while the Toronto-Winnipeg average price difference was $4.29 for the same time period.[1] Transportation costs and price differences between the Edmonton and Toronto markets over the longer time period from 1965 to 1977 seemed to have deviated from the expected relationship (Figure 7-9). It appears that arbitrage did not take place when price differences were greater than the cited transfer costs between markets. In the next section of this chapter, average price differences expressed in 1971 dollars, will be related to some evidence on transportation costs between markets.

It should be noted that there was no published data available on the actual interprovincial shipments of pork in Canada.[2] The Canadian Pork Council attempted to estimate

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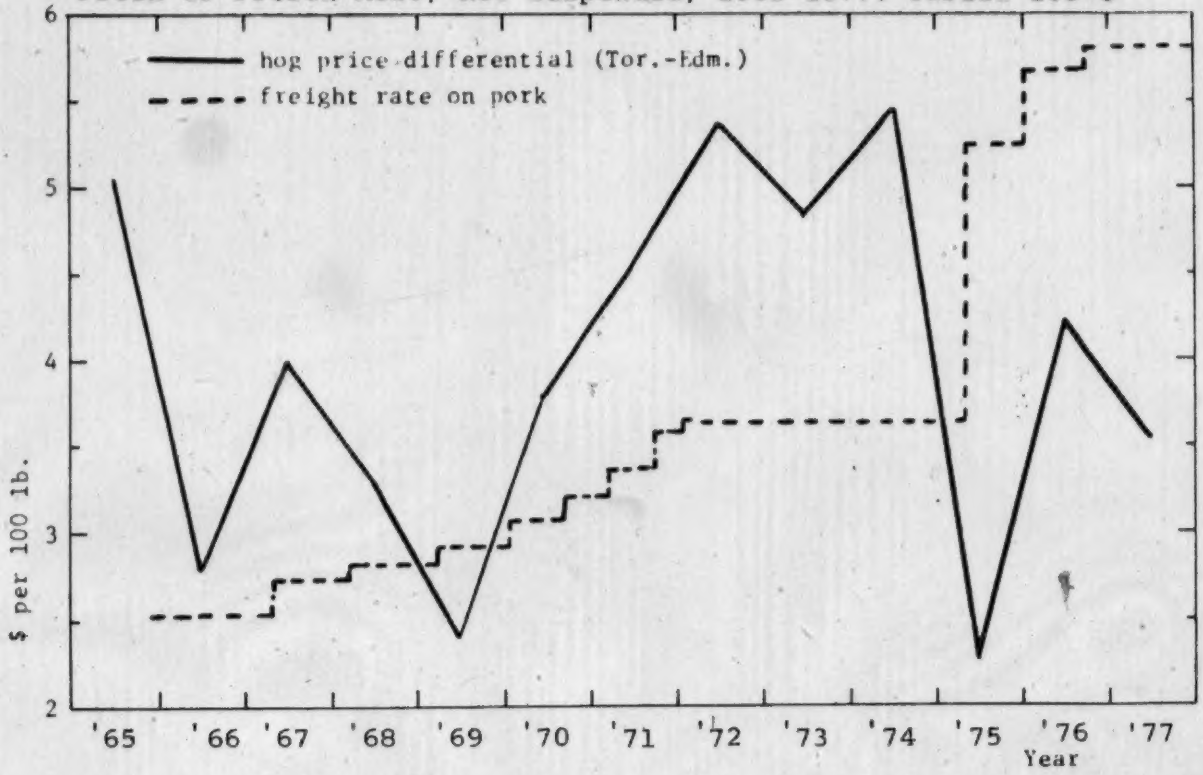
[1] Canadian Pork Council, op. cit., p. 1.1.

[2] Ibid., p. 5-6a; Interview with Lloyd Unterschultz, op.cit., 8 April 1981.

FIGURE 7-9

The Toronto-Edmonton Hog Price Differential Compared to a Rail Freight Rate on Fresh or Frozen Meat, Not Suspended, 1965-1977. Tariff 108-U



1 Pork shipments are typically made by truck and not rail. However, historical data on trucking rates are not readily available.

Source: Canadian Pork Council, Spatial Price Differences For Hogs in Canada (Ottawa, Ontario: March, 1979), p. 5.5.

interprovincial pork movement in Canada for 1971, 1974 and 1976. They indicated that most pork movements were in the fresh, chilled or frozen cut form. "More than half of the shipments from Alberta were destined for British Columbia, the remainder going to Ontario and Quebec. Saskatchewan sent much of its pork into Manitoba, and Manitoba shipped considerable quantities of pork into Ontario and Quebec."[1] Their estimates of interprovincial pork shipments were for 391 million pounds or 25 percent of the total Canadian pork production in 1971 and 224 million pounds or 20 percent of the total Canadian pork production in 1976. Such a drop in interprovincial pork shipments may have been due to Quebec's increased hog production and the reduction of hog production in the prairie provinces, though these estimates should be taken with a grain of salt as an earlier study by Hawkins and Manning indicated that 20 percent of the beef shipments from Alberta to Quebec go by truck.[2] The Canadian Pork Council assumed almost all beef shipments in Canada occurred by rail which may bias their estimates. It also appeared that during the 1970s much of the interprovincial movement of pork was due to transshipments of imports east through Ontario, and transshipments of exports west through British Columbia.[1] Available data show that the interprovincial shipment of live hogs has been minimal during the past 20 years. When the Ontario, Manitoba and Alberta markets are considered, the highest level of interprovincial shipment of hogs occurred from Manitoba to Alberta in 1978 and this represented only 2 percent of Manitoba's total hog production for that year.[2]

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[1] Canadian Pork Council, op. cit., p. 5.6a.

[2] M.H. Hawkins and T.W. Manning, A Study of the Montreal Wholesale Beef Trade, Agricultural Economics and Rural Sociology Research Bulletin 7 (Edmonton: University of Alberta, March 1973), p. 3.

The geographical distance between markets and the cost of transportation probably play a role in establishing price differences. However, from the wide and erratic shifts in price differences between markets, it is also evident that freight rates were only one of the factors affecting the price spreads between markets.

LEVEL AND VARIABILITY OF HOG PRICES DURING VARIOUS TIME PERIODS

Data on weekly prices for dressed weight hogs were obtained from 1961 to 1980 for the Edmonton, Winnipeg, and Toronto markets as were weekly average prices for the U.S. 7 markets. These price series were deflated by the consumer price index (1971 = 100) to give real prices in 1971 dollars. Comparisons of the level and variability of prices over six time periods are summarized in Table 7-2. The time periods

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[1] Canadian Pork Council, op. cit., p. 5.13.

[2] Agriculture Canada, Livestock Market Review, op. cit., 1968-1979.

TABLE 7-2

Level and Variability of Weekly Deflated Hog Prices

	Weekly Dressed Weight Hog Prices Paid to Producers, Canadian Dollars Per Hundredweight, Deflated by CPI, 1971 = 100					
	Entire Time Period (1961-1980)	Pre-Board (1961-Oct. 31,1969)	Post Board Pre Terminal (Nov. 1,1969-April 1,1975)	Post Board Terminal to Producer Acceptance (April 2,1975-Mar. 12,1978)	Post Board During Prod. Acceptance (Mar. 13,1978-Mar. 15,1980)	Post Board Government Intervention Sealed Bid (Mar.16,1980-Dec.31, 1980)
Edmonton						
Mean	34.62	33.80	33.13	41.10	35.56	27.43
Standard Deviation	6.96	4.45	8.39	7.20	5.48	4.68
Coefficient of Variation	0.20	0.13	0.25	0.18	0.15	0.17
Winnipeg						
Mean	35.39	35.36	34.13	40.43	34.79	27.22
Standard Deviation	6.76	4.62	8.34	6.92	5.37	4.47
Coefficient of Variation	0.19	0.13	0.24	0.17	0.15	0.16
Toronto						
Mean	37.80	37.75	37.10	43.41	35.10	29.04
Standard Deviation	6.76	4.31	8.29	6.86	5.18	4.45
Coefficient of Variation	0.18	0.11	0.22	0.16	0.15	0.15
U.S.						
Mean	33.77	32.39	33.64	38.92	34.98	27.72
Standard Deviation	7.02	5.15	8.37	7.28	6.11	4.59
Coefficient of Variation	0.21	.16	0.25	0.19	0.17	0.17

relate to various policy changes of the Board and are as follows: 1) The entire time period from 1961 to 1980, 2) the time period from 1961 until the implementation of the Board, that is, from 1961 to October 31, 1969, 3) the time period after the Board's establishment until the Board purchased assembly yards, that is, from November 1, 1969 to April 1, 1975, 4) the time period after the Board's purchase of assembly yards until the Board began its producer bid acceptance procedure, that is, from April 2, 1975 to March 12, 1978, 5) the time period during the producer bid acceptance program until government intervention, that is, from March 13, 1978 to March 15, 1980, 6) the time period after government intervention when the teletype system was replaced by sealed bids until the end of 1980, that is, from March 16, 1980 to December 31, 1980.

Table 7-2 summarizes the mean values, standard deviations and coefficients of variation about the mean for real hog prices in these various time periods for the four market areas. Inferences as to the effects of various policy changes of the Board in Alberta can be made from Table 7-2. There may have been changes in supply and demand conditions and other market variables. However, the Winnipeg, Toronto, and the United States' 7 market average weekly hog prices provide a fairly adequate basis of comparison.

There is evidence of increased week-to-week variability, measured by the coefficient of variation, in hog prices in

Alberta after the implementation of the Board. However, the other three market areas follow the same pattern of increased week-to-week variability in prices during the same time periods. Ranking the market areas from that with the highest week-to-week variability to that with the lowest variability in prices, the U.S. ranks highest, then Edmonton, Winnipeg, and Toronto. This order of ranking tends to occur during each of the six time periods shown on Table 7-2.

Table 7-2 also indicates the average level of producers' real prices for hogs during various time periods. Table 7-3 provides a more clearly-defined summary of the comparisons of average price differences for each of the six time periods between the various markets. The Edmonton-Winnipeg average price difference, in 1971 dollars, favored Winnipeg from 1961 to 1975. Over the periods from 1975 to the end of 1980, the Edmonton avereage hog price was above the Winnipeg average price by approximately 21 to 77 cents per hundredweight (Table 7-3)

Average price differences, in 1971 dollars, between the Edmonton and Toronto hog prices, favored the Toronto price during five of the time periods by approximately $1.60 to $4.00 per hundredweight. Prior to the inception of the Alberta Board, the average price in Toronto was above that in Edmonton by $3.95 per hundredweight. During the first five years of the Board's existence the average level

TABLE 7-3

Difference In Mean Values Between Various Market Areas

Market Areas Compared	Average Price Differences for Dressed Weight Hogs in Canadian Dollars Per Hundredweight,[1] Deflated by CPI, (1971 = 100)					
	Entire Time Period (1961-1980)	Pre Board (1961-Oct. 31,1969)	Post Board Pre Terminal (Nov.1,1969-April 1,1975)	Post Board Terminal to Producer Acceptance (April 2,1975-Mar. 12, 1978)	Post Board During Prod. Acceptance (Mar.13,1978-Mar.15,1980)	Post Board Government Intervention Sealed Bid (Mar.16,1980-Dec. 31,1980)
Edmonton-Winnipeg	-0.77	-1.56	-1.00	0.67	0.77	0.21
Edmonton-Toronto	-3.18	-3.95	-3.97	-2.31	0.45	-1.61
Edmonton-U.S.	0.85	1.41	-0.51	2.18	0.58	-0.29
Winnipeg-Toronto	-2.41	-2.39	-2.97	-2.98	-0.31	-1.82
Winnipeg - U.S.	1.62	2.97	0.49	1.51	-0.19	-0.05
Toronto-U.S.	4.03	5.36	3.46	4.49	.12	1.32

[1] These price differences are derived from Table 7-2.

of price difference still favored Toronto by about $4.00. From April, 1975 to March, 1978 when the Board operated assembly yards this average price difference decreased to $2.31 per hundredweight in favor of Toronto. Then, from March 1978 to March 1980, the Edmonton average price was higher than the Toronto average hog price by 45 cents per hundredweight. During most of 1980, after government intervention, the price average once again favored Toronto by $1.61 per hundredweight.

Winnipeg-Toronto price differences followed the same pattern as the Edmonton-Toronto average price differences. However, the price difference levels for hogs were higher for Winnipeg previous to 1975 and after 1975 the levels of average price differences were higher for Edmonton, when compared to Toronto. The time period when the Board used the producer bid acceptance procedure, from March 13, 1978 to March 15, 1980, seemed to represent the highest level of average hog prices for Edmonton and Winnipeg when compared to Toronto. The Edmonton average price was also 77 cents per hundredweight higher than the Winnipeg price during this same time period.

Edmonton-U.S. average price differences (expressed in Canadian dollars for dressed weight equivalent) differed somewhat from the pattern of price differences between the various Canadian markets (Table 7-3). From April, 1975 to March, 1978 the Edmonton-U.S. average price difference was highest at $2.18 per hundredweight. This pattern of price differences was expected since the Alberta plus British Columbia region was deficient in pork and the U.S. market had a pork surplus during this time period (Figure 7-7). On the other hand, from November, 1969 to April, 1975 the Edmonton-U.S. average price difference was lowest at 51 cents per hundredweight. Again, this was the expected pattern of price differences as the U.S. market was deficient in pork and the Alberta plus British Columbia region had a surplus in pork during this time period (Figure 7-7).

Winnipeg-U.S. price differences indicated that the average hog price for Winnipeg was higher than the U.S. average price from 1961 to 1978. This pattern of price differences did not totally reflect the deficient pork position of the U.S. market from 1971 to 1975 (Figure 7-7). After 1978, the price differences were close to zero, with the U.S. price being only slightly higher than the Winnipeg price which accurately reflected the Manitoba and the U.S. markets having similar quantities of surplus pork.

The Toronto-U.S. average price differences were always greater than zero for the six time periods from 1961 to 1980. From 1961 to 1969 the Toronto-U.S. average price difference was highest at $5.36 per hundredweight. This price difference along with the other Toronto-U.S. price differences prior to 1978, seems to have been excessive in relation to the earlier cited transfer cost between Toronto and Sioux

City, Iowa which was only $3.80 per hundredweight in 1978 (Figure 7-8). The Toronto-U.S. average price difference was lowest at 12 cents per hundredweight, from March 1978 to March 1980, which reflected both markets having similar quantities of surplus pork (Figure 7-7).

INTERPRETATION OF THE MEANS, STANDARD DEVIATIONS, AND COEFFICIENTS OF VARIATION

Table 7-2 indicates that the level of producers' real prices for hogs in Edmonton after the Board was implemented was substantially higher than in the period before the Board's inception, except for most of 1980. However, prices increased to similar levels in the other three market areas. When the price level in the Edmonton market is compared to the price levels for both Winnipeg and Toronto it is seen that the Edmonton price was highest after the Board introduced its producer bid acceptance program until the government intervened in the Board's selling system. It could, however, be argued that this condition occurred because the Ontario and Quebec area gained a surplus in pork while the Alberta and B.C. region was deficient in pork during this time period. However, during most of 1980, the Toronto price was above the Edmonton hog price as the Ontario and Quebec area remained in a surplus position. It might be argued that the Board's introduction of the producer bid-acceptance procedure allowed the pricing mechanism to behave according to regional supply and demand conditions and that as the government intervened in the Board's selling procedure, the pricing mechanism was not allowed to reflect regional supply and demand conditions. This suggestion will be analyzed further using an econometric model later in this chapter.

The coefficient of variation about the mean has indicated that the stability of producers' real prices for hogs has decreased in all four markets since 1970. Although this represents the time period since the Board was implemented, the Board probably had little or no influence on this increased week to week variability in Alberta, since the other markets had similar increases in price variability.

Comparing Table 7-3 with Figure 7-8 can give some indication as to whether the mean differences between prices are in line with the previously cited transportation costs. It seems that since 1975, all average mean differences, with the exception of the Toronto-U.S. average price difference from 1975 to 1978, have been less than the transportation costs between markets. When the Toronto price was compared to the other three markets considered in this study, prior to 1975, the average price differences tended to create mean differences greater than transportation costs. The cited freight rate was $2.79 in 1978 between Winnipeg and Toronto (Figure 7-8). Prior to 1975, the freight rate would have been less than $2.79, yet the mean difference (expressed in 1971 dollars) between these two markets was $2.39 from 1961 to 1969, and $2.97 from 1970 to 1975. The freight rate on pork between Edmonton and Toronto, before 1970 was less than $3.00 per hundredweight (Figure 7-9). However, the Edmonton-Toronto price difference (expressed in 1971 dollars) averaged $3.95 per hundredweight from 1961 to 1969 and $3.97 from 1970 to 1975. After 1975, the Edmonton-Toronto price difference was below transportation costs between these two markets. It would seem that after 1975 the differences between prices in different locations more accurately approximated to the minimum inferred cost of moving pork between markets, than had been the case prior to 1975. When the Board introduced the assembly yard system in 1975 and the producer bid-acceptance procedure in 1978, the Edmonton hog price seemed to be more reflective of the Winnipeg and Toronto average hog price.

When the weekly average U.S. 7 market price is used as a norm for comparison, implications concerning the Board's actions can be inferred. The Edmonton-U.S. average price differences tended to reflect accurate levels of price differences (Table 7-3) from 1961-1980 when demand and supply conditions for both market areas and transportation costs between markets were considered. The Winnipeg-U.S. average price differential appears to have been in line with transportation costs between markets but supply and demand conditions for both markets did not accurately reflect the level of all the price differences. This was particularly true from 1971 to 1975 as the U.S. market was deficient in pork and the Manitoba region had a surplus of pork while the Winnipeg average price was above the U.S. average price by 49 cents per hundredweight from 1970 to 1975. The Toronto-U.S. average price difference seemed to reflect the supply and demand conditions of both markets. However, prior to 1978 the Toronto-U.S. price differences appear to have had a tendency to be greater than transfer costs between these two markets. One could infer that the Alberta Pork Producers' Marketing Board has contributed to the Edmonton-U.S. average price difference being representative of the U.S. and Alberta plus British Columbia supply and demand conditions, and representative of transfer costs to the mid-west U.S. This seems particularly to be the case when the Winnipeg-U.S. and Toronto-U.S. average price differences are related to supply and demand conditions and also related transfer costs between markets and compared to the Edmonton-U.S. average price difference.

TESTING FOR PRICING EFFICIENCY IN SPATIALLY SEPARATED MARKETS USING CORRELATION COEFFICIENTS

The market areas used in this analysis were Edmonton, Winnipeg, Toronto, and the average for the 7 U.S. markets. Correlations between prices in these markets were calculated for dressed weight hogs in Canadian dollars during six different time periods from 1961 to 1980. A correlation coefficient of 1 would indicate perfect unison in price movements while a correlation coefficient of zero would indicate no relationship in price movements.

Table 7-4 is a matrix of correlation coefficients for weekly hog prices over the time period from 1961 to 1980. The correlation coefficients were .99 between the weekly prices in the Canadian markets and .98 between the weekly prices in the Canadian and U.S. market comparisons. The following null hypothesis was tested.

H_o: there was no significant relationship between hog prices in the four markets during the entire time period.

TABLE 7-4

Correlation Coefficients Between Weekly Prices of Hogs in Four Markets For the Time Period From 1961 to 1980

Market	Edmonton	Winnipeg	Toronto	U.S.
Edmonton	1.00			
Winnipeg	0.99	1.00		
Toronto	0.99	0.99	1.00	
U.S.	0.98	0.98	0.98	1.00

All of the correlation coefficients were statistically significant at the 1 percent level as the "t" values ranged from 150.23 to 369.7. Therefore, the null hypothesis was rejected.

Table 7-5 shows the correlation coefficients between the weekly prices of hogs in the four markets from 1961 to October 31, 1969. The highest correlation coefficient was .98 and the lowest coefficient was .86. All coefficients were significant at the 1 percent level. The null hypothesis that there was no relationship between hog prices in the four markets in the pre-Board time period was also rejected.

TABLE 7-5

Correlation Coefficients Between Weekly Prices of Hogs In Four Markets From 1961 Until the Board Was Implemented in Alberta (1961 to October 31, 1969)

Market	Edmonton	Winnipeg	Toronto	U.S.
Edmonton	1.00			
Winnipeg	0.97	1.00		
Toronto	0.96	0.98	1.00	
U.S.	0.86	0.91	0.90	1.00

Table 7-6 shows the correlation coefficients between the weekly hog prices in the four markets from November 1, 1969 to April 1, 1975. The highest correlation coefficient was .99 and the lowest correlation coefficient was .96. All coefficients were significant at the 1 percent level and the null hypothesis that there was no relationship between hog prices in these four markets during this time period was rejected.

TABLE 7-6

Correlation Coefficients Between Weekly Prices of Hogs In Four Markets For the Time Period From the Board's Establishment Until the Board Purchased Assembly Yards (November 1, 1969 to April 1, 1975)

Market	Edmonton	Winnipeg	Toronto	U.S.
Edmonton	1.00			
Winnipeg	0.99	1.00		
Toronto	0.99	0.99	1.00	
U.S.	0.96	0.96	0.96	1.00

Table 7-7 gives correlation coefficients for hog prices between four market areas from April 2, 1975 to March 12, 1978. The lowest coefficient was .91, while the highest was .99. All correlation coefficients were significant at the 1 percent level. The null hypothesis that there was no relationship between the movement of hog prices in the four markets during this time period was rejected.

TABLE 7-7

Correlation Coefficients Between Weekly Prices of Hogs In Four Markets For the Time Period From the Board's Purchase of Assembly Yards Until the Board Began Its Producer Bid Acceptance Procedure, (From April 2, 1975 to March 12, 1978)

Market	Edmonton	Winnipeg	Toronto	U.S.
Edmonton	1.00			
Winnipeg	0.97	1.00		
Toronto	0.96	0.99	1.00	
U.S.	0.91	0.92	0.91	1.00

The computed correlation coefficients for hog prices in the four market areas from March 12, 1978 to March 15, 1980 are shown in Table 7-8. The lowest correlation coefficient was .86 and the highest coefficient was .98. All correlation coefficients are statistically significant at the 1 percent level. The null hypothesis that there was no relationship among the movements of hog prices during this time period in the four market areas was, therefore, rejected.

TABLE 7-8

Correlation Coefficients Between Weekly Prices of Hogs In Four Markets During the Board Producer Bid Acceptance Procedure (March 12, 1978 to March 15, 1980)

Market	Edmonton	Winnipeg	Toronto	U.S.
Edmonton	1.00			
Winnipeg	0.98	1.00		
Toronto	0.98	0.96	1.00	
U.S.	0.89	0.86	0.88	1.00

Table 7-9 shows correlation coefficients for hog prices in the four markets from March 15, 1980 to December 31, 1980. The lowest coefficient was .92, while the highest was .99. Again, all correlation coefficients were significant at the 1 percent level. The null hypothesis that there was no relationship between hog prices in the four markets during this time period was rejected.

TABLE 7-9

Correlation Coefficients Between Weekly Prices of Hogs In Four Markets After the Teletype Discontinued And Government Intervention Took Place (March 15, 1980 to December 31,1980)

Market	Edmonton	Winnipeg	Toronto	U.S.
Edmonton	1.00			
Winnipeg	0.99	1.00		
Toronto	0.98	0.99	1.00	
U.S.	0.92	0.93	0.93	1.00

INTERPRETATION OF THE CORRELATION COEFFICIENTS

The basis for using correlation coefficients as a test for pricing efficiency is that the higher the correlation between price movements of a commodity in any two markets, the higher the relationship between the markets.[1] Thakur states that:

> Pricing efficiency depends upon the nature and extent of competition among the traders in the market. The effects of competition are reflected through prices. In a competitive market system, price movements in one market are considered to be closely related to price movements in other markets. The analysis of prices is thus believed to give a fairly good indication of the efficiency of the marketing system.[2]

Even though prices could be closely related between markets because of competitive forces, prices could also be closely related between markets because of collusion between traders. This possibility is not ruled out in applying this test to hog prices in Canada because of the highly concentrated packing plant industry in Canada which generally involves national firms.

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[1] Ume J. Lele, *op. cit.*, p. 259.

[2] D.S. Thakur, *op. cit.*, p. 66.

Correlation coefficients between weekly hog prices are very high (Tables 7-4 to 7-9). Most of these coefficients are close to 1 which shows close relationship between these price movements in various markets. The Canadian price movements were even more closely related to each other than were the Canadian and U.S. price movements. This could perhaps be due to the fact that the U.S. market applies to the average of 7 markets and is much larger than is the Canadian market. Canada and the U.S. have different grading systems for hogs. Therefore, the lack of homogeneity in the hogs of the two countries may cause lower correlations.

The correlation coefficients between weekly hog prices for Edmonton and the U.S. increased after the implementation of the Board. This increase in correlation between hog prices of these two markets could not be completely attributed to the Board's actions since both Winnipeg and Toronto prices had similar increases in correlation with the U.S. price movements, even though the increases were slightly lower. The greatest increase in correlation coefficients between prices in the Edmonton and U.S. markets occurred during the first five years of the Board's operation.

The conclusion could be made that the price movements for hogs in one market are influenced by price movements in other markets and that (in the absence of possible collusion among packing plants) the markets are fairly competitive. Even though this model measures the relationship of prices between markets it does not consider other variables such as the supply characteristics of the markets. Therefore, before any firm conclusion can be made regarding the competitiveness of the markets and pricing efficiency, the supply variables will be evaluated in Model 4 later in this chapter.

RESULTS OF MODEL 2, TESTING PRICING EFFICIENCY BY USING WEEKLY PRICE COMPARISONS IN AN ECONOMETRIC MODEL

In Model 2 (specified in Chapter V), price variables were used in an attempt to test pricing efficiency at the producer level. Table 7-10 summarizes the results of Model 2 which regressed weekly prices in one market on weekly price levels in an alternative market for the entire time period from 1961 to 1980. The signs of the estimated coefficients on the alternative market price variables were positive as was expected for each of the regressions. The estimates of the slope coefficients were each significant at the 99 percent confidence level. There was a high correlation between prices in each pair of different markets (the lowest coefficient of determination was .96). Trans-

TABLE 7-10

Results of Model 2: (Regressions of Prices In One Market on Weekly Prices In Alternative Markets For the Entire Time Period (1961 to 1980))

Variables	Fitted Regression Line Intercept	Estimated Coefficient	Standard Error of Slope Coefficient	Coefficient of Determination (R^2)	Durbin-Watson Statistic
X = Winnipeg (WN) Y = Edmonton ED)	ED = -2.6892 +	1.0520 (WN) (370.4) ***	.00284	.99	.542 +++
X = U.S. (OMC) Y = Edmonton (ED)	ED = 1.0247 +	.9976 (OMC) (156.1) ***	.00639	.96	.256 +++
X = Toronto (TN) Y = Edmonton (ED)	ED = -4.4683 +	.9926 (TN) (254.5) ***	.00390	.99	.409 +++
X = Toronto (TN) Y = Winnipeg (WN)	WN = -1.6044 +	.9943 (TN) (306.9) ***	.00324	.99	.394 +++
X = U.S. (OMC) Y = Winnipeg (WN)	WN = 3.0503 +	.9814 (OMC) (170.9) ***	.00574	.96	.273 +++
X = U.S. (OMC) Y = Toronto (TN)	TN = 5.6769 +	.9777 (OMC) (153.0) ***	.00639	.96	.266 +++

In this and following tables of results:
t values are given in parentheses
*** denotes 1 percent significance level and ** denotes 5 percent significance level for t-test
+++ denotes the hypothesis of no serial correlation is rejected at the 1 percent level
++ denotes the hypothesis of no serial correlation is not rejected at the 1 percent level
+ denotes the test for serial correlation is inconclusive at the 1 percent level

portation cost differences (dollars per hundredweight) between different markets were represented by the estimated intercept coefficients. For the Canadian markets, as expected, the magnitude of the estimated intercept coefficients appeared to reflect the distance between markets. The Toronto-Edmonton regression reflected the highest estimated intercept of $4.46 while the Toronto-Winnipeg regression gave the lowest estimated intercept of $1.60 per hundredweight. When the U.S. average market price was regressed on price levels in Canadian markets, the estimated intercept term seemed less reflective of distance. Toronto is much closer than is Edmonton to the midwest which is the major U.S. hog producing area, but the estimated intercept term was much higher for the Toronto-U.S. regression than for the Edmonton-U.S. regression.

It should be pointed out that these results are inefficient because of the presence of first-order autocorrelation. Therefore, the results cannot be interpreted with a high degree of confidence. Autocorrelation, that is, serial correlation in time series data, is evident from the Durbin-Watson statistic for these regressions.[1]

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[1] The Durbin-Watson Statistic (d) is computed as: $d = \frac{(u_i - u_{i-1})^2}{u_i^2}$ This approximates $d = 2\,(1-\rho)$ where ρ is the estimated first-order autocorrelation coefficient of the residuals in the model. As $\rho - 0$, $d - 2$. By examining a table for upper (d_u) and lower (d_L) bounds on this statistic for the appropriate degrees of freedom, the researchers can test the null hypothesis of autocorrelation. Source: Robert V. Bishop, "The Use and Misuse of Summary Statistics in Regression Analysis," Agricultural Economics Research, Vol. 33, No. 1, January 1981, p. 13.

> A bias is introduced into the traditional tests of significance when autocorrelated errors are present; this suggests that interpretation of these tests under autocorrelation is difficult if not impossible... If the error structure is first-order auto-regressive, the ordinary least squares (OLS) estimates of the regression parameters are (1) unbiased, (2) consistent, but (3) inefficient in small as well as in large samples... High R^2 values could be no more than a reflection of the fact that the dependent variable is highly autocorrelated and could easily be achieved simply by regressing the variable on its own past... It has been suggested that the regression results can be defined as "nonsense" if the R^2 measure exceeds that computed for the Durbin-Watson statistic.[1]

Since the results summarized in Table 7-10 indicate that the R^2 exceeds the computed Durbin-Watson statistic in each of the regressions, the results cannot be interpreted with a high degree of confidence. Autocorrelation occurred in the regressions during the other five time periods using weekly price comparisons, therefore, these results will not be discussed. However, there are methods for correcting for autocorrelation. A simple (but often effective) approach involves computing first differences of the data prior to estimation.[2] This approach is implemented in the following section of this chapter.

RESULTS OF MODEL 3, USING FIRST DIFFERENCES IN PRICES TO TEST PRICING EFFICIENCY

First differences of prices were computed for each of the four markets specified in this study. The regressions on first differences of prices between markets as illustrated in Model 3 (specified in Chapter V), were used to test pricing efficiency. This model was included in the analysis to reduce the problem of autocorrelation which was present in Model 2. The results of the regression on first differences in prices is of interest because the estimated coefficient of the intercept provides a measure of the average change in market differences from week to week for the various time periods.[1] The regressions on first differences were applied for the six time periods, outlined previously in this chapter, in order to compare any differences in the estimates of the intercept terms, slope coefficients, and coefficients of determination.

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[1] Robert V. Bishop, op. cit., pp.13-14.

[2] Ibid., p. ~~15.~~

Table 7-11 summarizes the results of first difference price regressions between markets for the entire time period. Each estimated regression equation had a positive sign, as was expected, on the slope coefficient implying that as the first difference of price in the alternative market increased, the first differences of prices in the original market would be expected to increase. For example, from Table 7-11, as the first differences in hog prices increased in Toronto by 1 dollar per hundredweight, the first differences of prices in Edmonton would be expected to increase by 61 cents per hundredweight. All of the estimated slope coefficients for

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[1] William G. Tomek, op. cit., 1980, p. 440.

TABLE 7-11

Results of Model 3: (First Difference Regressions for the Entire Time Period (1961 to 1980))

Variables	Fitted Regression Line For First Differences		Standard Error of Slope Coefficient	Coefficient of Determination (R^2)	Durbin-Watson Statistic
	Intercept	Estimated Coefficient			
X = Winnipeg (WN) Y = Edmonton (ED)	ED = .00981 +	.7784 (WN) (34.23) ***	.02274	.53	2.505 +[1]
X = U.S. (OMC) Y = Edmonton (ED)	ED = .02446 +	.3148 (OMC) (10.92) ***	.02884	.10	1.879 ++
X = Toronto (TN) Y = Edmonton (ED)	ED = .01562 +	.6063 (TN) (26.60) ***	.02279	.41	2.272 ++[1]
X = Toronto (TN) Y = Winnipeg (WN)	WN = .01216 +	.6501 (TN) (34.42) ***	.01889	.53	2.240 ++[1]
X = U.S. (OMC) Y = Winnipeg (WN)	WN = .0227 +	.3122 (OMC) (11.66) ***	.02677	.12	1.713 ++
X = U.S. (OMC) Y = Toronto (TN)	TN = .0234 +	.3101 (OMC) (10.17) ***	.03048	.09	1.859 ++

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[1] If the Durbin-Watson Statistic was greater than 2, then the Durbin Watson Statistic was tested against the alternative hypothesis of negative first order autocorrelation by computing (4-d) and this value was referred to d_L and d_u as if one were testing for positive autocorrelation. Source: J.Johnston, Econometric Methods (New York: McGraw-Hill Book Company, 1972), p. 252.

this time period were significantly different from zero at the 99 percent confidence level. The Durbin-Watson test statistics were all significantly different from zero at the 99 percent significance level except for the regression equation of first differences between Edmonton and Winnipeg. This model seems, therefore, to have been effective in reducing autocorrelation for these five price difference interactions. The Durbin-Watson statistic is given in each table (Tables 7-12 to 7-16) to indicate the presence or absence of autocorrelation at the 99 percent confidence level. The results from the regression equations with insignificant Durbin-Watson statistics are inefficient and cannot be interpreted with a high degree of confidence. The major purpose of using this model is to compare and explain the differences in results from the regression equations during various time periods. Therefore, each regression equation will not be discussed in detail.

Tables 7-11 through 7-16 indicate that all the estimated slope coefficients were significantly different from zero at the 99 percent confidence level. Results of Model 3 regressions between the three Canadian markets show, with two exceptions, similar estimated slope coefficients which usually ranged from .5 to .7, for all the time periods (Table 7-17). The two exceptions are for the Winnipeg-Edmonton first difference equations, where the estimated slope coefficients were at the higher levels of .92 and .98

TABLE 7-12

Results of Model 3: (First Difference Regressions for The Pra Board Period (1961 to October 31, 1969))

Variables	Fitted Regression Line For First Differences		Standard Error of Slope Coefficient	Coefficient of Determination (R^2)	Durbin-Watson Statistic
	Intercept	Estimated Coefficient			
X = Winnipeg (WN) Y = Edmonton (ED)	ED = .00760 +	.6525 (WN) (21.39) ***	.03051	.50	2.294 ++
X = U.S. (OMC) Y = Edmonton (ED)	ED = .01286 +	.2332 (OMC) (5.23) ***	.04453	.06	1.601 ++
X = Toronto (TN) Y = Edmonton (ED)	ED = .01239 +	.5607 (TN) (16.78) ***	.03342	.38	2.087 ++
X = Toronto (TN) Y = Winnipeg (WN)	WN = .01078 +	.6428 (TN) (18.42) ***	.03490	.42	2.258 ++
X = U.S. (OMC) Y = Winnipeg (WN)	WN = .01259 +	.2320 (OMC) (4.78) ***	.04852	.05	1.790 ++
X = U.S. (OMC) Y = Toronto (TN)	TN = .00551 +	.2865 (OMC) (5.88) ***	.04870	.07	1.829 ++

TABLE 7-13

Results of Model 3: (First Difference Regressions for the Time Period After the Board was Implemented Until It Purchased Assembly Yards (Nov. 1, 1969 to April 1, 1975))

Variables	Fitted Regression Line For First Differences Intercept	Estimated Coefficient	Standard Error of Slope Coefficient	Coefficient of Determination (R^2)	Durbin-Watson Statistic
X = Winnipeg (WN) Y = Edmonton (ED)	ED = .02382 +	.6921 (WN) (14.84) ***	.04664	.44	2.597 +
X = U.S. (OMC) Y = Edmonton (ED)	ED = .03821 +	.2535 (OMC) (5.46) ***	.04644	.10	1.989 ++
X = Toronto (TN) Y = Edmonton (ED)	ED = .01801 +	.5837 (TN) (12.10) ***	.04822	.34	2.446 +
X = Toronto (TN) Y = Winnipeg (WN)	WN = .00084 +	.6650 (TN) (16.29) ***	.04083	.49	2.354 ++
X = U.S. (OMC) Y = Winnipeg (WN)	WN = .02251 +	.3226 (OMC) (7.57) ***	.04259	.17	1.752 ++
X = U.S. (OMC) Y = Toronto (TN)	TN = .04158 +	.2581 (OMC) (5.56) ***	.04644	.10	1.689 ++

TABLE 7-14

Results of Model 3: (First Difference Regressions for Time Period After the Board Purchased Assembly Yards Until the Producer Bid Acceptance Procedure Began (April 2, 1975 to March 12, 1978))

Variables	Fitted Regression Line For First Differences		Standard Error of Slope Coefficient	Coefficient of Determination (R^2)	Durbin-Watson Statistic
	Intercept	Estimated Coefficient			
X = Winnipeg (WN) Y = Edmonton (ED)	ED = .02652 +	.9195 (WN) (13.75) ***	.06685	.55	2.585 +
X = U.S. (OMC) Y = Edmonton (ED)	ED = .07682 +	.3930 (OMC) (4.29) ***	.09154	.11	2.103 ++
X = Toronto (TN) Y = Edmonton (ED)	ED = .04498 +	.7173 (TN) (11.47) ***	.06255	.46	2.448 +
X = Toronto (TN) Y = Winnipeg (WN)	WN = .03001 +	.6844 (TN) (16.58) ***	.04128	.64	2.541 +
X = U.S. (OMC) Y = Winnipeg (WN)	WN = .07157 +	.2723 (OMC) (3.61) ***	.07533	.08	1.815 ++
X = U.S. (OMC) Y = Toronto (TN)	TN = .07854 +	.2338 (OMC) (2.60) ***	.09007	.04	1.914 ++

TABLE 7-15

Results of Model 3: (First Difference Regressions During the Producer Bid Acceptance Procedure Until Government Interferance (March 13, 1978 to March 15, 1980))

Variables	Fitted Regression Line For First Differences		Standard Error of Slope Coefficient	Coefficient Of Determination (R^2)	Durbin-Watson Statistic
	Intercept	Estimated Coefficient			
X = Winnipeg (WN) Y = Edmonton (ED)	ED = -.06556 +	.6806 (WN) (11.74) ***	.05797	.57	2.158 ++
X = U.S. (OMC) Y = Edmonton (ED)	ED = -.08217 +	.3690 (OMC) (3.71) ***	.09956	.12	1.486 +
X = Toronto (TN) Y = Edmonton (ED)	ED = -.06056 +	.5487 (TN) (9.19) ***	.05973	.45	1.760 ++
X = Toronto (TN) Y = Winnipeg (WN)	WN = -.01589 +	.6391 (TN) (10.04) ***	.06367	.49	1.826 ++
X = U.S. (OMC) Y = Winnipeg (WN)	WN = -.04156 +	.4265 (OMC) (3.88) ***	.11006	.13	1.470 +
X = U.S. (OMC) Y = Toronto (TN)	TN = -.09337 +	.3083 (OMC) (2.45) **	.12602	.06	1.779 ++

TABLE 7-16

Results of Model 3: (First Difference Regressions for the Time Period After Government Intervention Until the End of 1980 (March 16, 1980 to December 31, 1980))

Variables	Fitted Regression Line For First Differences		Standard Error Of Slope Coefficient	Coefficient Of Determination (R^2)	Durbin-Watson Statistic
	Intercept	Estimated Coefficient			
X = Winnipeg (WN) Y = Edmonton (ED)	ED = -.02711 +	.9827 (WN) (10.65) ***	.09225	.74	2.534 ++
X = U.S. (OMC) Y = Edmonton (ED)	ED = .17666 +	.3071 (OMC) (2.71) ***	.11342	.16	1.556 ++
X = Toronto (TN) Y = Edmonton ED)	ED = .11871 +	.4766 (TN) (4.32) ***	.11023	.32	1.894 ++
X = Toronto (TN) Y = Winnipeg (WN)	WN = .12489 +	.5509 (TN) (7.07) ***	.07792	.56	2.027 ++
X = U.S. (OMC) Y = Winnipeg (WN)	WN = .20692 +	.3137 (OMC) (3.26) ***	.09620	.21	1.587 ++
X = U.S. (OMC) Y = Toronto (TN)	TN = .15084 +	.5642 (OMC) (4.83) ***	.11678	.37	2.040 ++

TABLE 7-17

Estimated Slope Coefficients for Model 3

Time Period	First Differences Edmonton With			First Differences Winnipeg With		First Differences Toronto With
	Winnipeg	U.S.	Toronto	Toronto	U.S.	U.S.
1961 - 1980	.7784	.3148	.6063	.6501	.3122	.3101
1961 - Oct.31,1969	.6525	.2332	.5607	.6428	.2320	.2865
Nov.1,1969- April 1,1975	.6921	.2535	.5837	.6650	.3226	.2581
April 2,1975- March 12,1978	.9195	.3930	.7173	.6844	.2723	.2338
March 13,1978- March 15,1980	.6806	.3690	.5487	.6391	.4265	.3083
March 16,1980- December 31,1980	.9827	.3071	.4766	.5509	.3137	.5642

for two of the time periods. When first differences of prices for the three Canadian markets are regressed on the first difference of the U.S. average market price, the estimated slope coefficients were less, and usually ranged from .2 to .4. However, the last time period, during most of 1980, was an exception. The U.S.-Toronto equation has an estimated slope coefficient of .56, while the U.S.-Edmonton and U.S.-Winnipeg equations still had slope coefficients close to .3.

Table 7-18 gives a summary of the coefficients of determination for the Model 3 versions for the six time periods. For Model 3, coefficients of determination between Edmonton price and the U.S. average price increased gradually from .06 for the first time period, before the inception of the Board, to .16 for the last time period, representing most of 1980. The coefficients of determination between prices for the Winnipeg and the U.S. followed a pattern of similar increases (during the same time periods) although the increases were not as even and gradual. The coefficients of determination between prices for the Toronto and the U.S. regression equations followed a different pattern as they went from .07 before the Alberta Board's establishment, then increased to .10, dropped to .04 and .05 and finally increased to .37. The coefficients of determination for the first difference of prices between the three Canadian markets followed each other fairly closely and generally ranged between the values of .30 and .60.

TABLE 7-18

Coefficients of Determination for Model 3

Time Period	First Differences Edmonton With			First Differences Winnipeg With		First Differences Toronto With
	Winnipeg	U.S.	Toronto	Toronto	U.S.	U.S.
1961 - 1980	.53	.10	.41	.53	.12	.09
1961 - Oct.31,1969	.50	.06	.38	.42	.05	.07
Nov. 1.1969- April 1,1975	.44	.10	.34	.49	.17	.10
April 2,1975- March 12,1978	.55	.11	.46	.64	.08	.04
March 13,1978- March 15,1980	.57	.12	.45	.49	.13	.06
March 16,1980- December 31,1980	.74	.16	.32	.56	.21	.37

INTERPRETATION OF THE RESULTS OF THE FIRST DIFFERENCE EQUATIONS

The slope coefficients summarized in Table 7-17 seem to follow fairly stable patterns between time periods and between market areas. As mentioned previously, the estimated slope coefficients derived from the regression equations between the three Canadian markets were higher than the estimated slope coefficients derived from the regression equations between the U.S. and the three Canadian markets. This would imply that the first difference of prices would be expected to increase more in one of the specified Canadian markets if the first difference of hog prices increased in magnitude in one of the alternative markets in Canada rather than in the U.S. market. This would infer that the prices in the Canadian markets are more sensitive to each other than to the U.S. average price.

The coefficients of determination seem to be relatively stable between the different time periods and between the various market areas of the study (Table 7-18). Even though, from tests of Model 3, the coefficients of determination between the Edmonton and U.S. prices increased in magnitude after the Board's inception, similar increases in the coefficients of determination occurred in the first difference equations between the Winnipeg and U.S. prices. The results from Model 3 also indicate that the coefficients of determination between the Toronto and U.S. prices showed increases for two time periods since 1974. It could be argued that the first difference of prices for the three specified Canadian markets were related more to the first difference of prices for the U.S. market, after 1970, because of the marketing procedures undertaken by each of the three hog marketing Boards in Alberta, Manitoba and Ontario.[1] The results of Model 3, which used first difference price data for the different market areas, gives some evidence that the Alberta Marketing Board's policy changes had an impact, in that, the regression results of Model 3 improved after the Board's inception. The results seem to indicate that after 1970 the pricing efficiency of hog marketing in Alberta, Manitoba and, to a lesser degree, in Ontario increased when compared to the average U.S. market price. Improvements in pricing efficiency will be interpreted further in the next model as supply variables of each market will be considered in an econometric model.

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[1] The Alberta Pork Producers' Marketing Board, the Ontario Pork Producers' Marketing Board and the Manitoba Hog Producers' Marketing Board have used similar selling strategies to market hogs (i.e.: teletype auction, assembly yard system, and daily code-a-phone service). Sources: Ontario Pork Producers' Marketing Board, "The Development and Operations of the Ontario Pork Producers' Marketing Board," Toronto, Ontario, 1980. (Mimeographed.); Interview with Bill Munro, General Manager of Manitoba Hog Producers' Marketing Board, Edmonton, 15 April 1981.

RESULTS OF MODEL 4 WHICH TESTS PRICING EFFICIENCY USING SUPPLY VARIABLES IN AN ECONOMETRIC MODEL

As specified in Model 4 of Chapter V, the influence of supply variables on the weekly differences in hog prices between various markets was assessed in tests of pricing efficiency. The supply variables considered for Alberta, Manitoba, and Ontario were the weekly federally inspected slaughter numbers for hogs. These slaughter numbers were for the province in which the hogs originated. The variable chosen to represent U.S. supply influences was the weekly slaughter numbers for hogs for that entire country (in thousands of head). With the exception of Manitoba which was always surplus in pork during the specified time period, dummy variables were included in an attempt to capture the influence of trade surplus or deficit situations in pork for each market region.

The initial ordinary least-squares (OLS) regression estimates were inefficient because of the presence of first-order autocorrelation, and thus could not be interpreted with a high degree of confidence. Therefore, the Cochrane-Orcutt Iterative Technique (CORC) was used in Model 4 to correct autocorrelation.[1] All of the results reported in the following Tables 7-19 to 7-24 refer to the CORC transformation technique. The only two exceptions are the regression results found in Tables 17-20 and 17-23 which used the OLS procedure during the last time period.

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[1] The CORC method is a way of estimating the parameters of a linear equation with autoregressive disturbances that does not assume an arbitrary value of one for rho (ρ)... The equation involves transformation of the original observations on Y_t and X_t to $Y_t - \rho Y_t - 1$ and $X_t - \rho X_t - 1$ respectively. Source: M. Dutta, Econometric Methods (Cincinnati, Ohio: South-Western Publishing Co., 1975), pp. 115-116.

Each model was tested with data for the six time periods specified earlier and also for an additional time period which represented the post-Board time period from November 1, 1969 to December 31, 1980. The time series began with the year 1962 rather than 1961 because the computing technique could only use up to 1000 observations. The major purpose of using Model 4 was to compare any difference in results from the regression equations during various time periods and between different market areas. If the regression results had greater explanatory power (measured by the coefficients of determination and significance levels of the estimated coefficients) during different time periods, then it could be concluded that the supply variables influenced the price difference between markets more during those time periods. Alternatively, this could also indicate that pricing efficiency was enhanced during those time periods with the highest level of explanatory power.

Table 7-19 presents the results of the CORC transformed equations for Model 4-1. The signs of the estimated B_1 coefficients were expected to be negative and this turned out to be so for all the time periods except 1978 to 1980.

TABLE 7-19

Results of Model 4-1: (Relationship of Supply Variables on Weekly Hog Price Differences Between the Edmonton and Winnipeg Markets)

Model 4-1: EDWN = $B_O + B_1EDS + B_2WNS + B_3D_1 + u$

Time Period	Intercept	Estimated Coefficients				
		B_1	B_2	B_3	R^2	D.W.
1962-1980	- .5904 (-3.202)***	-.0000112 (-1.512)	-.0000123 (-.912)	2.1351 (9.048)***	.674	2.260++
1962-October 31, 1969	-1.4322 (-5.154)***	-.000000082 (- .0118)	.0000080 (.4310)		.759	2.391++
November 1,1969-December 31,1980	- .3173 (- .750)	-.0000134 (- .970)	-.0000142 (-.598)	1.9188 (7.475)***	.586	2.149++
November 1,1969-April 1, 1975	-1.3515 (-3.047)***	-.0000347 (-2.376)**	.0000617 (2.257)**	1.4384 (2.824)***	.342	2.167++
April 2,1975-March 12, 1978	1.4341 (1.527)	-.0000250 (- .675)	.0000097 (.133)		.410	2.179++
March 13,1978-March 15, 1980	.3412 (1.354)	.000242 (6.685)***	-.000265 (-5.508) ***		.661	1.895++
March 16,1980-December 31,1980	1.3315 (1.061)	-.000148 (-1.619)	.000164 (1.209)		.235	2.036++

Cochrane-Orcutt Iterative Technique was used for all regressions.

In this and all following tables of results:
t values are given in parentheses
*** denotes 1 percent significance level, ** denotes 5 percent significance level, and
* denotes 10 percent significance level for t-test
++ denotes the hypothesis of no serial correlation is not rejected at the 1 percent level
+ denotes the test for serial correlation is inconclusive at the 1 percent level
EDWN = Edmonton weekly hog price minus Winnipeg weekly hog price
EDS = Alberta weekly hog slaughter numbers
D_1 = Dummy variable for surplus (deficit) pork effect in the Alberta plus British Columbia region: 0 if surplus, 1 if deficit.
WNS = Manitoba weekly hog slaughter numbers

TABLE 7-20

Results of Model 4-2: (Relationship of Supply Variables on the Weekly Hog Price Differences Between the Edmonton and Toronto Markets)

Model 4-2: $EDTN = B_o + B_1EDS + B_2TNS + B_3D_1 + B_4D_2 + u$

		Estimated Coefficients					
Time Period	Intercept	B_1	B_2	B_3	B_4	R^2	D.W.
1962-1980[2]	- .7553 (-2.104)**	-.0000443 (-5.244)***	.0000378 (5.816)***	.0145 (.046)	-3.4839 (-9.132)***	.745	2.160 ++
1962-October 31, 1969[2]	-3.9405 (-11.857)***	-.0000186 (-2.767)***	.0000254 (4.249)***			.748	2.217 ++
November 1,1969-December 31,1980[2]	-3.7579 (-4.266)***	-.0000743 (-4.741)***	.0000605 (5.497)***	.6590 (1.304)	-1.476 (-2.555)***	.688	2.148 ++
November 1,1969-April 1, 1975[2]	-5.2607 (-8.962)***	-.0000712 (-4.729)***	.0000592 (4.326)***	.6409 (1.009)		.437	2.176 ++
April 2,1975-March 12, 1978[2]	-8.4398 (-4.533)***	-.0000490 (-1.319)	.0000918 (3.362)***		1.6203 (1.272)	.450	2.065 ++
March 13,1978-March 15, 1980[2]	- .1321 (- .357)	.0000509 (.763)	.0000068 (.260)			.487	1.745 ++
March 16,1980-December 31,1980[1]	-3.879 (-1.459)	-.000814 (-5.424)***	.000324 (4.624)***			.44	1.481 ++

[1] Ordinary Least Squares (OLS) only

[2] Ordinary Least Squares with Cochrane-Orcutt Iterative Technique

EDTN = Edmonton weekly hog price minus Toronto weekly hog price
TNS = Ontario weekly hog slaughter numbers
D_2 = Dummy variable for surplus (deficit) pork effect in the Ontario plus Quebec region: 0 if surplus, 1 if deficit
All other variables are as previously defined

TABLE 7-21

Results of Model 4-3: (Relationship of Supply Variables on the Weekly Price Differences Between the Edmonton and the Average of the U.S. 7 Markets (Canadian $ Dressed Weight Equivalent))

Model 4-3: $EDUS = B_O + B_1EDS + B_2USS + B_3D_1 + B_4D_3 + u$

Time Periods	Intercept	B_1	Estimated Coefficients B_2	B_3	B_4	R^2	D.W.
1962-1980	- .2595 (- .436)	-.0000094 (- .974)	.001149 (3.094)***	.1067 (.143)	-.7811 (-1.291)	.773	1.994 ++
1962-October 31, 1969	-1.4749 (-1.590)	-.0000091 (-1.095)	.001967 (4.864)***		-.1008 (- .155)	.887	2.087 ++
November 1,1969-December 31,1980	-1.0031 (- .801)	-.0000191 (-1.127)	.001176 (2.005)**	1.3319 (1.322)	-.1775 (- .185)	.723	1.945 ++
November 1, 1969-April 1, 1975	-1.8935 (-1.354)	-.00000134 (- .075)	.000641 (.922)	-1.7171 (-1.098)	1.1086 (1.013)	.720	1.871 ++
April 2, 1975-March 12, 1978	.5520 (.225)	-.0000225 (- .498)	.002702 (1.613)*		-1.2775 (- .8019)	.587	2.020 ++
March 13, 1978-March 15, 1980	- .2111 (- .212)	-.0000380 (- .729)	.000711 (.710)			.729	1.640 ++
March 16, 1980-December 31,1980	.6788 (.1523)	-.000225 (-2.108)**	.00317 (1.161)			.635	1.725 ++

OLS with Cochrane-Orcutt Iterative Technique only

EDUS = Edmonton weekly hog price minus U.S. 7 market average weekly hog price
USS = U.S. weekly hog slaughter numbers
D_3 = Dummy variable for surplus (deficit) pork effect in the U.S. market: 0 if surplus, 1 if deficit
All other variables are as previously defined

TABLE 7-22

Results of Model 4-4: (Relationship of Supply Variables on the Weekly Hog Price Differences Between the Winnipeg and Toronto Markets)

Model 4-4: $WNTN = B_o + B_1 WNS + B_2 TNS + B_3 D_2 + u$

Time Periods	Intercept	B_1	B_2	B_3	R^2	D.W.
		Estimated Coefficients				
1962-1980[2]	-1.3805 (-3.690)***	-.0000995 (-7.184)***	.0000455 (8.241)***	-2.106 (-5.384)***	.761	2.242++
1962-October 31, 1969[2]	-2.560 (-8.900)***	-.0000598 (-3.156)***	.0000276 (4.333)***		.649	2.200++
November 1,1969-December 31,1980[2]	-4.256 (-7.126)***	-.0001064 (-4.828)***	.0000639 (7.078)***	- .6170 (-1.357)	.652	2.193++
November 1,1969-April 1, 1975[2]	-3.9641 (-8.543)***	-.000198 (-8.545)***	.0000935 (8.396)***		.568	2.104++
April 2, 1975-March 12, 1978[2]	-7.9121 (-6.577)***	-.0000370 (- .647)	.0000569 (2.653)***	1.2515 (1.750)*	.283	2.145++
March 13, 1978-March 15, 1980[2]	- .7155 (-1.048)	.000111 (2.247)**	-.0000061 (-.390)		.707	1.600++
March 16, 1980-December 31,1980[1]	-2.686 (-1.217)	-.000493 (-3.094)***	-.000124 (2.478)***		.20	1.555++

[1] OLS only

[2] OLS with Cochrane-Orcutt Iterative Technique

WNTN = Winnipeg weekly hog price minus Toronto weekly hog price
All other variables are as previously defined

TABLE 7-23

Results of Model 4-5: (Relationship of Supply Variables on the Weekly Hog Price Differences Between Winnipeg and the Average of the U.S. 7 Markets (Canadian $ Dressed Weight Equivalent))

Model 4-5: $WNUS = B_o + B_1WNS + B_2USS + B_3D_3 + u$

Time Periods	Intercept	Estimated Coefficients B_1	B_2	B_3	R^2	D.W.
1962-1980	.0528 (.096)	-.0000112 (- .594)	.001194 (3.384)***	-.1729 (-.306)	.758	1.898++
1962-October 31, 1969	.2034 (.285)	-.0000106 (- .435)	.001600 (3.635)***	.2345 (.363)	.796	2.190++
November 1,1969-December 31,1980	-1.0782 (-1.028)	-.0000047 (- .168)	.001270 (2.295)**	.2601 (.289)	.725	1.825++
November 1,1969-April 1, 1975	-1.2375 (-.924)	-.0000034 (- .112)	.000936 (1.478)	.8162 (.792)	.743	1.685++
April 2, 1975-March 12,1978	-.9803 (-.421)	-.0000323 (- .384)	.00298 (1.885)*	-.8326 (-.557)	.589	1.885++
March 13, 1978-March 15, 1980	-.6865 (-.604)	.000128 (2.023)**	-.001757 (-1.777)*		.765	1.755++
March 16, 1980-December 31,1980	-.7047 (-.166)	-.000190 (-1.193)	.00227 (.820)		.613	1.659++

OLS with Cochrane-Orcutt Iterative Technique only

WNUS = Winnipeg weekly hog price minus U.S. 7 market average weekly hog price
All other variables are as previously defined

TABLE 7-24

Results of Model 4-6: (Relationship of Supply Variables on the Weekly Hog Price Differences Between the Toronto and the Average of the U.S. 7 Markets (Canadian $ Dressed Weight Equivalent))

Model 4-6: $TNUS = B_o + B_1TNS + B_2USS + B_3D_2 + B_4D_3 + u$

Time Periods	Intercept	Estimated Coefficients B_1	B_2	B_3	B_4	R^2	D.W.
1962-1980	.4182 (.507)	-.0000318 (-3.796)***	.001584 (3.886)***	3.2041 (3.690)***	.7709 (1.298)	.797	1.849 ++
1962-October 31, 1969	2.0972 (2.629)***	-.00000494 (- .663)	.001596 (3.925)***	.3757 (.6020)		.850	2.091 ++
November 1,1969-December 31,1980	2.0765 (1.466)	-.0000467 (-3.750)***	.001863 (3.030)***	2.075 (1.807)*	.9392 (.956)	.744	1.818 ++
November 1, 1969-April 1,1975	1.5963 (1.149)	-.0000090 (- .568)	.000995 (1.425)		2.1960 (2.350)**	.722	1.742 ++
April 2, 1975-March 12, 1978	5.3769 (1.591)	-.000101 (-2.763)***	.00436 (2.439)**	.8559 (.423)	-.6507 (-.435)	.567	1.842 ++
March 13, 1978-March 15, 1980	.02325 (.025)	-.000107 (-3.268)***	.003289 (2.159)**			.672	1.315 +
March 16, 1980-December 31,1980	5.1671 (1.278)	-.000069 (-1.521)	.001877 (.776)			.654	1.686 ++

OLS with Cochrane-Orcutt Iterative Technique only

TNUS = Toronto weekly hog price minus U.S. 7 market average weekly hog price
All other variables are as previously defined

The signs on the estimated B_2 coefficients were positive, as was expected, with the exception of the entire time period (1961-1980) and from 1978 to 1980. The signs of the estimated B_3 coefficients were positive as was expected for each time period where this variable was included. The Alberta supply variable had no significant influence on the Edmonton-Winnipeg price differences except for two time periods after the Board's inception. The Manitoba supply variable was also significantly related to the Edmonton-Winnipeg price difference for the time periods tested, except for the same two time periods after the Board's inception. However, the dummy variables indicate the surplus or deficit position in pork for Alberta plus British Columbia was significantly related to the Edmonton-Winnipeg price difference for each time period where this variable was included. Before the Board's inception (1962-1969) the coefficient of determination was .76 and it decreased to .59 for the time period after the Board's formation (1970-1980). During the last time period, for most of 1980, the coefficient of determination decreased to its lowest level of .24.

The results of similar regressions of the CORC transformed iterative technique for Model 4 are summarized in Tables 7-20 to 7-24. The major purpose of using this model was to compare and, hopefully, explain any differences in results from the regression equations during various time periods.

As the results of Model 4-2 and 4-4 indicate in (Tables 7-20 and 7-22) these two models have the highest number of significant estimated coefficients. This might suggest that the Edmonton-Toronto and Winnipeg-Toronto price differences were both explained by significant supply variables for the respective markets during most of the time periods. Model 4-2 also suggests that the surplus or deficit position in pork of the Ontario plus Quebec region was significantly related to the Edmonton-Toronto price difference. However, the surplus and deficit pork position of the Alberta plus British Columbia region was not significantly related to the Edmonton-Toronto price difference (Table 7-20). Results of Models 4-3 and 4-5 indicate that for most of the time periods the U.S. slaughter numbers were significantly related to the respective Edmonton-U.S. and Winnipeg-U.S. price differences. However, the Alberta slaughter number variables in Model 4-3 and the Manitoba slaughter number variables in Model 4-5 were not significantly related to the respective Edmonton-U.S. and Winnipeg-U.S. price differences for most of the time periods. Results of Model 4-3 also indicates that the surplus or deficit pork position of both the U.S. and Alberta plus British Columbia regions were not significantly related to the Edmonton-U.S. price differences. Additionally, results of Model 4-5 indicate that the surplus or deficit pork position of the U.S. were not significantly related to the Winnipeg-U.S. price differences.

The Ontario supply variable was significantly related to the Toronto-U.S. price differences during four of the seven time periods tested (see results of Model 4-6 in Table 7-24). The U.S. supply variable was significantly related to the Toronto-U.S. price differences during five of the seven time periods. For some of the time periods the deficit or surplus pork position of the U.S. and the Ontario plus Quebec regions was significantly related to the Toronto-U.S. price differences.

Table 7-25 provides a summary of the estimated coefficients of determination for the previously outlined Models (4-1 to 4-6) for each of the seven time periods. With the exception of the Winnipeg-Toronto price difference equation, the coefficeints of determination always decreased from the second to third time periods (which represent pre-Board and post-Board time periods respectively, for Alberta). For most of the price difference equations the coefficients of determination for time periods after the Board's inception were reduced. The coefficients of determination for the price difference equations between the three Canadian markets and the U.S. were generally higher than the coefficients of determination for the price difference equations between the three Canadian markets.

TABLE 7-25

Coefficients of Determination for Model 4

Time Periods	Weekly Price Spreads Edmonton with Winnipeg (Model 4-1)	Toronto (Model 4-2)	U.S. (Model 4-3)	Weekly Price Spreads Winnipeg with Toronto (Model 4-4)	U.S. (Model 4-5)	Weekly Price Spreads Toronto with U.S. (Model 4-6)
1962-1980	.674	.745	.773	.761	.758	.797
1962-October 31, 1969	.759	.748	.887	.649	.796	.850
November 1,1969-December 31,1980	.586	.688	.723	.652	.725	.744
November 1,1969-April 1, 1975	.342	.437	.720	.568	.743	.722
April 2, 1975-March 12, 1978	.410	.450	.587	.283	.589	.567
March 13, 1978-March 15, 1980	.661	.487	.729	.707	.765	.672
March 16, 1980-December 31, 1980	.235	.440	.635	.200	.613	.654

INTERPRETATION OF THE RESULTS OF MODEL 4

There was evidence of multicollinearity between several variables which made the interpretation difficult for some of the versions of Model 4.[1] For example, the supply variables were highly correlated for most of the models and time periods, which was a logical expectation. As the hog slaughter of one market area was increased (decreased), the hog slaughter of the alternative market would be expectdd to increase (decrease). Multicollinearity is present in most tests of economic relationships due to the interdependence of economic variables. "There is no conclusive evidence concerning the degree of collinearity with, if present, will affect seriously the parameter estimates."[2] It has been suggested that multicollinearity is severe if the simple correlation between two regressors is greater than the coefficient of determination.[3] For Model 4-1, during the entire time period, the R^2 was .67 (Table 7-19) while the simple correlation between Alberta and Manitoba slaughter numbers was .75. Therefore, multicollinearity could be a serious problem in this equation. Correlation coefficients between the slaughter number variables for various markets are shown in Table 7-26. The correlation coefficients were highest during the time period from March 1978 to March 1980 for each model.

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[1] Multicollinearity arises from the presence of interdependence, or lack of interdependence among the regressors in a multivariant equation. Multicollinearity occurs when the assumption that each of the regressors is linearly independent of all others is violated. Multicollinearity usually exists in varying degrees in economic data so the issue is how severe it is in a specific model. If it is severe then it may contribute to serious specification error.; Source: M. Dutta, Econometric Methods (Cincinnati, Ohio: South-Western Publishing Co., 1975), pp. 142-150.

[2] A. Koutsoyiannis, Theory of Econometrics (London: The MacMillian Press Ltd., 1978), p. 233.

[3] M. Dutta, op.cit., p. 150.; For additional tests for determining multicollinearity see: A. Koutsoyiannis, op. cit., pp. 238-249.

The significance levels of the estimated coefficients seemed to remain the same for the pre-Board (1962-1969) and post-Board (1969-1980) time periods for each model. However, during some of the shorter time periods after the Board's inception, which represented policy changes of the Board, there were changes in the significance levels of the estimated coefficients. For example, Alberta and Manitoba supply variables were significantly related to the Edmonton-Winnipeg price difference during only two time periods, from November 1, 1969 to April 1, 1975 and from March 13, 1978 to March 15, 1980 (Table 7-19). Models 4-2 and 4-3 also indicate that during some of the time periods after the inception of the Board, the supply variables were not significantly related to the price differences.

The coefficients of determination tend to be relatively stable between the different models for the same time periods. For the first three versions of Model 4 (Model 4-1, 4-2, and 4-3) which related the price differences between Edmonton and the other three specified markets, the coefficients of

TABLE 7-26

Correlation Coefficients Between Slaughter Number Variables of Various Markets

Time Periods	Weekly Slaughter Numbers Alberta with			Weekly Slaughter Numbers Manitoba with		Weekly Slaughter Numbers Ontario with
	Manitoba (Model 4-1)	Ontario (Model 4-2)	U.S. (Model 4-3)	Ontario (Model 4-4)	U.S. (Model 4-5)	U.S. (Model 4-6)
1962-1980	.747	.837	.800	.759	.774	.939
1962-October 31, 1969	.482	.415	.206	.633	.542	.657
November 1,1969-December 31,1980	.858	.409	.450	.484	.521	.722
November 1,1969-April 1, 1975	.777	.647	.449	.642	.450	.663
April 2, 1975-March 12, 1978	.703	.475	.166	.614	.414	.639
March 13, 1978-March 15, 1980	.963	.986	.975	.967	.962	.986
March 16, 1980-December 31,1980	.899	.881	.519	.839	.555	.593

determination were lower after the Board's inception. However, of the four time periods after the Board's inception, the coefficients of determination were highest from 1978 to 1980, while they were lowest for most of 1980. This could infer that after the Board's inception, the relationship between the Edmonton-Winnipeg, Edmonton-Toronto, and Edmonton-U.S. price differences and the supply variables was greatest during the producer-bid acceptance procedure. This relationship was lowest after the government intervened with the Board's selling system. Similar decreases in the coefficients of determination also occurred in the other three versions of Model 4 (Models 4-4, 4-5, and 4-6) after 1969, the year which represented the Board's formation.

The results of each model version indicated that the significance levels of the estimated coefficients and the coefficients of determination tended to decrease, after 1969, that is, after the Board's formation. The conclusion could be made that the supply variables generally influenced the price differences between the four markets to a greater degree before 1970. This could also indicate that the pricing efficiency of the hog marketing system in Alberta was reduced somewhat after the Board's formation. However, these results could also indicate that before 1970 the national packing plants bid according to formula pricing which was based on central markets (Toronto and the major U.S. markets). After 1970, the three provincial marketing boards could have exerted more competitive pressure on the packing plants. These actions could have caused the price differences to be more significantly related to the local supply variables than to the U.S. supply variables, after 1970. The overall conclusion can be made from this model which included supply variables that none of the three hog marketing boards specified in this study enhanced the pricing efficiency of hog marketing.

Inferences can also be made concerning the effects of the supply variables on the various price differences. The Edmonton-U.S. and Winnipeg-U.S. price differences appeared to be influenced more by the U.S. slaughter numbers than by the Alberta or Manitoba slaughter numbers. However, the Toronto-U.S. price difference seemed to be influenced by both the Ontario and U.S. slaughter numbers. The three Canadian markets (Edmonton, Winnipeg, and Toronto)-U.S. price differences tended to be unaffected by the U.S. pork surpluses or deficits. The Edmonton-Toronto and Winnipeg-Toronto price differences both tended to be responsive to the respective market supply variables. The Edmonton-Toronto price difference was also responsive to the Ontario plus Quebec region being surplus and deficit in pork, but it was not responsive to the Alberta plus British Columbia region being surplus or deficit in pork. The Edmonton-Winnipeg price difference seemed to be unaffected by both the Alberta and Manitoba slaughter numbers. However, this price difference was influenced by the Alberta plus British Columbia region being surplus or deficit in pork. Therefore, one could conclude that the Edmonton-Winnipeg, Edmonton-Toronto, and Winnipeg-Toronto price differences were influenced more significantly by the U.S. slaughter numbers than by the regional Canadian slaughter numbers, which was probably due to the U.S. market being much larger. One could conclude that the Canadian market price differences were more closely related to the Ontario slaughter numbers and the surplus or deficit position of the Ontario plus Quebec region than to the supply conditions of the alternative markets of Alberta and Manitoba. This was probably also due to the Ontario plus Quebec region being larger.

LIMITATIONS OF THE EMPIRICAL RESULTS

Models 1, 2 and 3 each related hog prices from one market to hog prices in an alternative market. However, Model 4 related some characteristics of supply and demand for hogs in different markets to price differences between the various markets. Since price levels are determined by the factors determining supply and demand, most confidence in the relationship posited could thus likely be given to the results of Model 4. The results of Models 1, 2 and 3 were also taken to indicate that the markets were fairly competitive but these results could also indicate collusive actions among the packing plants. Chapter III described the lack of competition among the packing plants in the Alberta market.

Therefore, the results of the four models in this chapter would tend to be influenced by the conduct in this oligopsonistic market.

CHAPTER VIII

A SUMMARY OF RESULTS, CONCLUSIONS, AND RECOMMENDATIONS

INTRODUCTION

This chapter will provide a summary of the results of this study. Some evidence of oligopsonistic conduct will be outlined which existed among the packing plants in Alberta. A summary of improvements in market information will be outlined. Results from the analysis of operational efficiency and pricing efficiency will also be given. Other results of this study will be summarized. Finally, the major conclusions and recommendations of this study will be outlined.

RESULTS CONCERNING THE CONDUCT AMONG THE PORK PACKING PLANTS IN ALBERTA

The packing plant industry for pork in Alberta is highly concentrated with the five largest firms controlling over 95 percent of the hog purchases. This type of market structure normally leads to interdependent market conduct.

1) The Alberta pork processing plants have exhibited market sharing as the four major packing plants had fairly constant market shares throughout 1972, 1974, and 1976. In contrast, the volume of hogs purchased by the packing plants during these three years varied substantially.

2) Short-run price fixing was suggested among the pork packing plant industry. This behavior was illustrated in Alberta where many consecutive hog sales, during certain days, were at the same price, while in Ontario the hog price constantly fluctuated during the same time periods.

3) Price leadership was another type of conduct displayed by the packing industry. During two and a half months in 1980 two packers were consistently the highest bidders while two other packers were consistently the lowest bidders. This type of bidding pattern could be expected to emerge in an oligopsonistic situation.

4) There were some indications that cost-plus-markup pricing was practiced within the pork processing industry. The margins between producer and wholesale pork prices were larger in Alberta than in the American Pacific northwest and eastern Canada. Producers generally perceive that the pork processors set their wholesale price, calculate revenue from the cut-up hog, subtract a desired operating margin, with the result being the amount they will pay for hogs.

RESULTS CONCERNING MARKET INFORMATION

The Board, acting as the single selling agency for hogs in Alberta, has provided the organizational structure for developing improvements in market information.

1) In 1972, the Alberta Hog Journal (known as the Western Hog Journal after 1979) commenced quarterly publication and provides information on hog market outlooks and forecasts. It includes regular summaries of retail and wholesale pork prices, which attempts to supplement the producers' understanding of price relationships between provinces and levels of marketing.
2) Market information in the form of a weekly newsletter is distributed by the Board to producers. This newsletter provides daily prices and volumes of the major hog markets in Canada and the United States for the previous week.
3) Another major source of current market information provided by the Board, which began in June 1978, is the daily toll free code-a-phone service. This system allows producers, assemblers, truckers and other interested parties in Alberta the opportunity to obtain current market information concerning prices in the major Canadian and U.S. markets.

4) Each of the Board's nine districts in Alberta, employ a director and five delegates. This should provide an atmosphere for a strong communications network. A producer can maintain close contact with his director or delegate (who is generally well informed on hog market information) concerning needed information which could assist him in making business decisions.

RESULTS CONCERNING OPERATIONAL EFFICIENCY

Various actions and policy changes of the Board have reduced marketing costs associated with different sectors of the pork industry, thus increasing the operational efficiency of hog marketing.

1) In 1973, the Producers' Hog Indemnity Fund was started by the Board. This replaced the transit insurance coverage on slaughter hogs previously covered by private insurance companies. In 1980, the insurance costs through the Producers' Hog Indemnity Fund were 19 cents per hog, while commercial insurance costs ranged from 32 cents to 1 dollar per hog, depending upon the transportation distance. This program also involves an ongoing hog death loss prevention program. The level of hog losses has averaged 1.74 per thousand head per year, since 1974, which is favorable when compared with other areas.

2) In 1975, the Board began operating marketing yard terminals at six locations in Alberta. The Board's assembly yard system has helped reduce assembly costs through economies of size and by using assembly yards adapted to handling hogs. When expressed in 1971 dollars, assembly costs have decreased from 45 cents per hog in 1971 to 29 cents per hog in 1979.

3) The sales department of the Board is responsible for efficient allocation of hogs to the packing plants. Previous to the Board and the implementation of this allocation system, Edmonton packers on occasion purchased large portions of Grande Prairie hogs, causing the Grande Prairie packing plant to purchase its requirements in the Edmonton area. Since the allocation system, the packing plants do not bid on a particular lot of hogs, but on a certain number of hogs. The hogs are then delivered to the closest packing plants resulting in reduced transportation costs.

4) Income from the "check float mechanism" was a source of revenue to the packing plants before the Board's inception, but it now accrues to the Board. In 1979, interest accruing to the Board was $466,437 which was used to help cover administrative costs and was mainly generated through the check float mechanism.

This is an indirect benefit to the producers since their marketing levies are probably reduced as result of the additional revenue.

5) The Board's data processing department provides various services and statistical information which was previously provided by government or by the packing plants. These functions are performed by the Board as a free service for other sectors of the pork industry and are not necessarily a cost savings for the Board. However, when the Board performs these tasks rather than each individual packing plant, economies of scale and technological efficiencies are possibly created, thus benefiting the entire pork industry.

6) Carcass identification is necessary to ensure efficient movement and proper identification of hogs and settlement to the producer. A program which started in 1973, and is a service performed by the Board for Agriculture Canada, explains to producers the importance of and proper methods of tattooing carcasses.

RESULTS CONCERNING PRICING EFFICIENCY

Pricing efficiency was more difficult to evaluate. However, it was assessed both subjectively and through empirical analysis.

SUBJECTIVE ASSESSMENT

1) The Alberta Hog Trading Company Limited was established in 1978 as a wholly owned subsidiary of the Board. Under normal circumstances, the Trading Company purchases hog for customers in the U.S. or other provinces, in direct competition with Alberta packing plants. The Trading Company will occasionally help correct disruptions in the market place such as exporting hogs during packing house strikes, and importing hogs to Alberta for market related reasons such as the occurrence of market arbitrage.

2) In 1978, domestic hog contracting began with the packing plant industry. Hogs were priced on a formula basis which was derived from a combination of current hog prices in major Canadian and U.S. markets.

3) Through forward contracting of hogs, for export, the Board's primary objective was to reduce market uncertainty and risk, allowing hog producers a base for future business decisions. The hog prices for Japanese export contracts are calculated by an ongoing cost and price adjustment formula which is based on the changing cost of feed inputs going into the production program.

4) In February 1981, the Board purchased and assumed control of Fletcher's Ltd., a pork processing operation. Although the effects of this action have not been assessed, the Board's primary objectives are to increase pricing efficiency and develop long term export markets in the Pacific northwestern U.S. and the offshore markets.

RESULTS OF EMPIRICAL ANALYSIS

1) After 1975, the price differences between the four markets specified in this study (Edmonton-Winnipeg, Edmonton-Toronto, Edmonton-U.S., Winnipeg-Toronto, Winnipeg-U.S. and Toronto-U.S.) appeared to be more accurately approximated to the minimum cost of moving pork between markets, than had been the case prior to 1975. As the Board introduced its assembly yard system in 1975, and its producer bid-acceptance procedure in 1978, the Edmonton average hog prices appeared to be more reflective of the Winnipeg and Toronto average hog price.

2) The price movements for hogs in one market seemed to be highly related to price movements in other markets indicating (in the absence of possible collusion among the packing plants) that the markets were fairly competitive.

3) Models 3 and 4 and the graphical analysis of Chapter VII tend to indicate that after the Board's inception, certain time periods reflected more efficient results (measured by the coefficient of determination for the models and by visual inspection of the graphs). The relationship between the Edmonton-Winnipeg, Edmonton-Toronto, and Edmonton-U.S. price differences and the supply variables was greatest during the producer-bid acceptance procedure. This relationship was lowest after the government intervened with the Board's selling system. Other results indicated that the Board's assembly yard system and producer-bid acceptance procedure (1975-1980) enhanced these price differences which were more related to demand and supply conditions and other market prices than when the government intervened in 1980.

4) It could be argued that the first difference of prices for the three specified Canadian markets were more fully explained, after 1970, by the first difference of prices for the U.S. market. This could have resulted from the marketing procedures undertaken by each of the three hog marketing boards in Alberta, Manitoba and Ontario. The results of Model 3 tend to indicate that after 1970 the pricing efficiency of hog marketing in Alberta, Manitoba, and to a lesser degree, Ontario, increased when compared to the average U.S. market price.

5) As specified in Model 4, the supply variables appeared to influence the price differences between the four markets to a greater degree before 1970. Therefore, one could conclude, from this model, that neither of the three hog marketing boards specified in this study enhanced the pricing efficiency of hog marketing.

OTHER RESULTS

This study produced other results relating to hog marketing and to the relationship between various markets.

1) The intermarket price spreads between the four markets, considered in this study, generally appeared to follow a two to four year cyclical pattern.
2) The level of producers' real prices for hogs (expressed in 1971 dollars) was substantially higher in all four markets after 1970, with the exception of 1980.
3) Since 1970, the variability of producers' real prices for hogs (1971 dollars) has increased in all four markets specified in this study.
4) The Canadian markets' price movements were more closely related to hog price movements in the other Canadian markets than to price movements in the U.S.
5) Model 4 and the graphical illustration of Chapter VII indicated that little relationship existed be-

tween the surplus or deficit position of pork in the U.S. and the difference in prices between the U.S. and Canadian markets. However, the surplus or deficit position of pork in the Ontario plus Quebec region and, to a smaller degree, the Alberta plus British Columbia region, were related to the Canadian price differences. Alternatively, the Edmonton-U.S., Winnipeg-U.S., and Toronto-U.S. hog price differences were more significantly related to the U.S. slaughter numbers than to the respective regional Canadian slaughter numbers.

6) Hog price differences for the three Canadian markets were more significantly related to the Ontario slaughter numbers and the surplus or deficit position of pork in the Ontario plus Quebec region than to the supply conditions of the alternative Alberta or Manitoba markets.

CONCLUSIONS

The analysis of this study, while subject to certain limitations, led to the following conclusions.

1) The quantity and quality of hog market information have increased since the inception of the Alberta Pork Producers' Marketing Board. Market information is also more current and more evenly distributed among producers. Improvements in market information should increase the operational and pricing efficiency

of the Alberta hog marketing system. Producers should be able to make more accurate and timely decisions concerning the production and marketing of hogs.

2) The Board has contributed to improvements in operational efficiency of marketing hogs in Alberta. This conclusion was reached by evaluating the cost reductions which have occurred in the marketing system. Cost savings have been introduced through the Board's establishment of the Producers' Hog Indemnity Fund and assembly yard system. The Board's sales department and data processing department have also shown aspects of increased operational efficiency through their hog allocation system, "check float mechanism", and hog settlement procedure.

3) There was mixed evidence from this study on improved pricing efficiency. After the Board's inception the pricing efficiency of hog marketing seemed to be enhanced. This is shown in Model 3 which used alternative price variables. It also seemed to be enhanced as transportation costs were related to the price differences between markets. However, evidence from Model 4 which used supply variables as a measurement device indicated that after the Board's inception improvements in pricing efficiency were lacking.

The overall conclusion was that the market performance of the hog marketing system in Alberta has improved since the Board began operation. More specifically, the Board's selling procedures improved market information and operational efficiency. However, a firm conclusion concerning pricing efficiency could not be made because of mixed evidence on improved pricing efficiency, since the Board's inception.

OTHER MARKET RELATED CONCLUSIONS

1) Supply conditions of the much larger U.S. and Ontario markets seem to influence the price differences between Edmonton and the other three markets more than the supply conditions in the much smaller Alberta market.
2) Government intervention seemed to have adverse affects on the pricing efficiency of hog marketing during 1980.
3) The highly concentrated packing plant industry for pork in Alberta has shown some types of oligopsonistic conduct in its behavior. There is some evidence that the packing plants may have practiced market sharing, covert agreements, and price fixing. It was argued that cost plus markup pricing was also practiced. These types of conduct were possibly practiced because of the nature of the product.

RECOMMENDATIONS

The following recommendations arise partially from the limitations of this study and partially from the analysis and assessment of market performance.

1) Co-operative selling through a single selling agency (such as the Board) could improve the market performance of other agricultural marketing sectors (such as for other farm products or other countries). This agency could implement such techniques as centralized selling through a teletype auction system, and computerized data processing. Many cost savings could occur through economies of size, assembly yard systems, insurance funds, and settlement procedures.
2) It is recommended that there be additional collection of data. The specific types of data should be interprovincial movement of pork products, quarterly per capita consumption of pork, and quarterly human population estimates by province. These data would allow for more timely examination of pork demand and analysis of the regional flow of pork between provinces.
3) The Combines investigation authorities should restrict the conduct of the Alberta pork packing plant industry and the food retailing industry more than it has done previously. No firm should be allowed to control more than 25 percent of a market. Concentration ratios

for the four largest firms of an industry should also be kept below 75 percent. This should provide a more competitive market situation and reduce some types of oligopolistic conduct.

4) More attention should be given to the supply and demand characteristics of the Alberta, Ontario and U.S. markets. This study has indicated that pricing efficiency seemed to be enhanced when transportation costs and alternative price variables were considered in the analysis. However, when supply and demand variables were considered in the analysis, pricing efficiency did not seem to be enhanced. If the supply and demand variables were studied and analyzed carefully, then the Board and producers could be more aware of hog prices that should prevail in Alberta.

5) The Alberta Department of Agriculture should become well informed and work closer with organizations (such as the Board) to avoid disruptions in the market place (such as intervention with the Board's selling system in 1980). For a short period of time, action by the government discontinued the Board's power to set the range for the hog price. The Board then seemed to seek for other ways of influencing the price, such as purchasing a packing plant. However, it is recommended that the Board continue to aggres-

sively use their power to set the price range and that the government allow the Board to do so without interference.

RECOMMENDATIONS FOR FUTURE RESEARCH

1) Three to five years from now, the producer-owned packing plant should be evaluated to determine if it has enhanced the pricing efficiency of hog marketing and expanded the export market for pork in the U.S. Pacific northwest. If improvements were found, this could have important implications for other agricultural sectors regarding integration into the processing industry.
2) Future research should be done to determine if cyclical patterns occur in the price spreads between markets. Cyclical patterns seemed to be evident in this study in the graphical illustration of price spreads between markets, although no empirical analysis was used to determine the cyclical relationships. The Box and Jenkins technique or other procedures could be used to estimate these cycles. These findings could be used for predictive purposes in estimating future price spreads between markets.
3) The market performance of the pork processing and food retailing industry could be evaluated and the results could be combined with this study. This would give an overall analysis of the entire pork

industry and attention could be given to those sectors where inefficiencies or abuse of market power were found.

4) Future research should also be done to analyze the possibilities and benefits of using the futures market as a hedging device for hog producers. If the research was favorable then the commodity futures market could be used by hog producers and by the Board in an attempt to reduce risk and increase and stabilize income to producers. This practice could also help improve the pricing efficiency of hog marketing. The Board could provide the expertise necessary to allow producers the opportunity to hedge their hogs on a futures market. Hedging could be done on an individual basis or the Board could provide the mechanism for several producers to negotiate together on a contract.

This study provides a basis for other research in the area of market performance. It is hoped that other researchers will use the background literature and methodology implemented in this study as a foundation for future research.

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